COMMONWEALTH of VIRGINIA

Draft Interim Nutrient Cap Strategy for the Shenandoah and Potomac River Basins

Draft of Available Actions and Options for Public Review and Comment

March 2001

Produced by

Virginia Department of Environmental Quality
Virginia Department of Conservation and Recreation

Assisted by

Chesapeake Bay Local Assistance Department
Virginia Cooperative Extension
Northern Virginia Regional Commission
Northern Neck Regional Commission
RADCO Regional Commission
Lord Fairfax Planning District Commission
Rappahannock-Rapidan Regional Commission
Central Shenandoah Planning District Commission
Metro Washington Council of Governments
Potomac Watershed Council
Shenandoah Valley Pure Water 2000 Forum

Table of Contents

Table of Contents (continued)

List of Figures

List of Tables

I. Introduction to the Interim Nutrient Cap Strategy

A. A Draft for Public Input and Feedback

This draft *Interim Nutrient Cap Strategy for the Shenandoah and Potomac River Basins* explores options for maintaining, or "capping," the reduced annual loads of nutrients that have been achieved as a result of the 1996 *Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy*. It also proposes a process for determining appropriate roles and responsibilities in future reduction efforts and a system to track reductions and their sources.

Public participation and stakeholder involvement have been the foundation of Virginia's continuing efforts to reduce the flow of nitrogen and phosphorus into the Shenandoah and Potomac rivers. The purpose of this draft is to encourage comments from citizens, local officials and stakeholders on the options presented, and how these options can be improved or enhanced. Comments on the document will be accepted through June 1, 2001.

Written comments may be e-mailed to *mpcarolan@deq.state.va.us* or mailed to:

Mary P. Apostolico, Potomac Watershed Manager
Division of Soil and Water Conservation
Virginia Department of Conservation and Recreation
98 Alexandria Pike, Suite 33
Warrenton, VA 20186

Collin H. Powers, Environmental Specialist II
Chesapeake Bay Program Office
Virginia Department of Environmental Quality
PO Box 10009
Richmond, VA 23240-0009

Three public informational meetings will be held. At these meetings attendees can discuss the draft with state planning staff and share comments in writing or verbally. Meetings will be held in April or May 2001 in the Northern Virginia, Northern Neck and Shenandoah Valley Regions.

B. Virginia's Continuing Commitment to Correcting Nutrient-Related Water Quality Problems in the Chesapeake Bay and its Tributaries

This interim cap strategy is part of a continuing pledge to improve water quality in the Chesapeake Bay and its tributaries that traces its origins to the 1983 Chesapeake Bay Agreement and outlines ambitious new obligations through 2010. Virginia and its

partners in these efforts remain committed to a voluntary and cooperative nutrient reduction strategy approach to achieve the goal of water quality improvement.

While dubbed “interim,” this strategy comes at a critical juncture. It strives to build on and maintain the reductions already achieved, in the face of a rapidly changing landscape and population growth throughout the region. It also leads the way for a new set of nutrient reduction goals being developed to support the watershed’s living resources without reliance on future regulations.

An Historic Agreement

In the early 1980s, the Chesapeake Bay was a resource in decline. Water quality degradation played a key role in the decline of living resources in the Bay and its tidal tributaries.

In 1983 the governors of Virginia, Maryland and Pennsylvania were joined by the mayor of Washington, D.C., the U.S. EPA administrator and the chairman of the tri-state, legislative Chesapeake Bay Commission to sign an agreement working toward the restoration of the Chesapeake Bay. This agreement created a multi-jurisdictional, cooperative partnership known as the Chesapeake Bay Program. The program sought to restore the Bay and its resources through cooperation and voluntary actions.

An over abundance of nutrients was identified as the most damaging water quality problem facing the Bay and its tributaries. High levels of nutrients, primarily phosphorus and nitrogen, over-fertilize the Bay waters, causing excess levels of algae. These algae can have a direct impact on submerged aquatic vegetation by blocking light from reaching these plants. More importantly, these algae have an indirect effect on levels of dissolved oxygen in the water. As algae die off and drop to the bottom, the resulting process of biological decay robs the surrounding bottom waters of oxygen, needed by oysters, fish, crabs and other aquatic animals.

The 1987 Bay Agreement recognized the role nutrients played in the Bay’s problems and committed to reducing controllable annual nitrogen and phosphorus loads into Bay waters by 40 percent by 2000. It was believed a 40 percent reduction would substantially improve the problem of low dissolved oxygen, which affects the Bay and many of its tributaries.

Nutrient Reduction Tributary Strategies Initiated

In 1992, Virginia joined her Chesapeake Bay Program partners in determining that the most effective means of reaching that water quality goal would be to develop tributary-specific nutrient reduction strategies in each Chesapeake Bay river basin.

These strategies were to address the two main categories of nutrient pollution that enter Chesapeake Bay and its tributaries. One is "point source" pollution, which refers to discharges of treated wastewater from industries and sewage treatment plants. The other

is "nonpoint source" pollution, which refers to diffused pollutants that are washed off of the land during the natural process of rainwater flowing across the ground into rivers, streams and the Bay.

Late in 1996 Virginia released the *Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy*. The result of more than three years of work, the 1996 strategy was the first important step toward reaching our 40 percent nutrient reduction goal in the Shenandoah-Potomac basin.

Developed cooperatively with local officials, farmers, wastewater treatment plant operators and other representatives of point sources and nonpoint sources of nutrients in the basin, the strategy set a realistic commitment of reducing nitrogen and phosphorus by approximately 37 percent before the end of the year 2000. As a result of the strong support for this grass-roots approach, the 1997 Virginia General Assembly adopted the Water Quality Improvement Act to provide cost-share funding for implementation of tributary strategies.

Virginia's local governments, farmers, businesses and citizens have been very successful in implementing the 1996 Shenandoah and Potomac tributary strategy. With a combination of a strong stewardship ethic and financial assistance through the Water Quality Improvement Fund, the people of the Shenandoah-Potomac basin have nearly achieved all of the strategy's reduction commitments.

Maintaining Our Progress

The primary need for a cap strategy results from the changing land use patterns and increasing wastewater treatment flows associated with population growth in the Shenandoah-Potomac basin. A comparison of the 1990 population to the recently released 2000 census figures reveals the following trends in the basin:

Table 1 1990-2000 Population Changes in the Shenandoah-Potomac Basin

Tributary Strategy Region	1990 Population	2000 Population	Numeric Change	Percent Change
So. Shenandoah	210,201	242,894	32,693	15.6%
No. Shenandoah	137,549	162,105	24,556	17.9%
No. Virginia	1,576,446	1,962,782	386,336	24.5%
No. Neck	39,531	45,780	6,249	15.8%
Totals	1,963,727	2,413,561	449,834	22.9%

- So. Shenandoah = Counties of Augusta, Highland, Page, Rockingham; Cities of Harrisonburg, Staunton, Waynesboro.
- No. Shenandoah = Counties of Clarke, Frederick, Shenandoah, Warren; City of Winchester.
- No. Virginia = Counties of Arlington, Fairfax, Fauquier, Loudoun, Prince William, Stafford; Cities of Alexandria, Fairfax City, Falls Church, Manassas, Manassas Park.
- No. Neck = Counties of King George, Northumberland, Westmoreland.

Just over one-third of Virginia's total population now resides in the Shenandoah-Potomac basin. Between 1990 and 2000, the population growth rate in this basin was more than double the rate for the rest of the State (23 percent compared to 10.4 percent). Accommodating future growth and maintaining the nutrient load reductions achieved to date will be a challenge that underscores the need for a dynamic and flexible cap strategy.

The Interim Nutrient Cap Strategy is the next important step in Virginia's nutrient reduction program for the Shenandoah and Potomac rivers. The objective of the *Interim Nutrient Cap Strategy for the Shenandoah and Potomac River Basins* is to determine the lines of responsibility for no net increase in nutrient loading. In doing so, a successful strategy will include effective tracking and equitable implementation. The strategy is not intended to cap growth in the basin, but is designed to cap the nutrient load impacts associated with that growth.

Building upon the collaborative efforts used to implement the original Shenandoah and Potomac tributary strategy, the cap strategy will seek to "close the gap" on the 40 percent reduction goal and maintain or "cap" that level of reduction. More than a continuation of practices used in the tributary strategy is needed. It will mean identifying new solutions, practices and partnerships. This draft strategy explores avenues that can be taken in seeking these new solutions.

The Next Steps

While the Interim Nutrient Cap Strategy can be seen as the final step in reaching the 40 percent reduction goal for the Shenandoah and Potomac, it actually paves the way for a long-term effort. This new effort is one of the key commitments in the new Chesapeake Bay Agreement signed in June 2000.

Chesapeake 2000, A Watershed Partnership commits to "achieve and maintain the water quality necessary to support the aquatic living resources of the Bay and its tributaries and to protect human health." Meeting this commitment through a continuation of the Bay Program's voluntary, cooperative approach also alleviates the need for regulations to meet the same standards.

The U.S. Environmental Protection Agency proposed implementation of a Total Maximum Daily Load (TMDL) regulatory program under Section 303(d) of the Clean Water Act to address nutrient-related problems in much of Virginia's Chesapeake Bay and tidal tributaries. In May 1999, EPA included Virginia's portion of the Bay and several tidal tributaries on the federal list of impaired waters based on failure to meet standards for dissolved oxygen and aquatic life use attainment.

This regulatory action is counter to the voluntary and cooperative nature of the Bay Program agreements. In Virginia it would effectively supplant the nutrient-reduction goals, programs and methods that were agreed upon by citizens, businesses and local officials across Virginia's Bay watershed. In addition, it could lead to overlap of government programs and confusion among citizens.

With these problems in mind Virginia led an effort to keep nutrient reductions outside the regulatory arena by structuring the new Bay Agreement, *Chesapeake 2000*, to include those commitments needed to remove the Bay and tidal tributaries from the TMDL list prior to regulatory action. The year 2010 has been identified as the milestone for achievement of the improved water quality conditions.

Virginia and her Chesapeake Bay Program partners have agreed upon the steps needed to achieve the 2010 goal. First, a scientific process will be undertaken to characterize the water quality and habitat conditions (termed "environmental endpoints") needed to restore aquatic life in the Bay and its tributaries. Next, the Chesapeake Bay Watershed and Water Quality models will be used to determine the levels of nutrient and sediment reductions that will be needed to achieve these conditions. It is likely that this process will result in revisions to the 40 percent nutrient reduction goal; and it is for this reason that the present nutrient cap strategy is considered to be "interim." If the reduction goals are changed, then our nutrient loading cap will also change.

This cooperative process is important for Virginians in all the Chesapeake Bay watersheds. By integrating our cooperative nutrient reduction program with the goals of the Clean Water Act Impaired Waters Program, it is hoped that Virginia can avoid the imposition of a TMDL regulatory program for nutrient reduction. The U.S. Environmental Protection Agency has agreed that no regulatory program will be imposed if the Bay and its tributaries meet the selected environmental endpoints by the year 2011.

Virginia's current success in meeting nutrient reduction commitments in the Shenandoah-Potomac basin has shown that a voluntary, cooperative approach can work. It has also shown that broad stakeholder support is necessary to make it work. The agricultural community and local wastewater treatment operators have played the major roles in meeting our nutrient reduction commitments to date. To maintain these reductions in this rapidly changing basin we will need new unprecedented levels of support from local governments, state agencies, regional authorities and the citizenry in general. Without this support, the people of these watersheds face the inevitability of increased federal regulations.

II. Development of the Interim Nutrient Cap Strategy

Public involvement and a local approach are particularly important to the success of the Interim Nutrient Cap Strategy because citizens and officials must understand the long-term need to maintain the water quality benefits and living resource improvements achieved through the 1996 Shenandoah and Potomac Tributary Strategy.

To institute the process for developing the Interim Nutrient Cap Strategy, a presentation was made before the Virginia Watershed Permitting and Planning Coordination Task Force. The task force, composed of directors of state agencies whose programs address or affect watershed management issues, supported the effort and directed staff of the Departments of Environmental Quality (DEQ) and Conservation and Recreation (DCR) to proceed with development.

A state agency nutrient cap strategy team was then formed and determined that the development process should be guided by a larger steering committee including regional representatives from agencies across the basin. This steering committee was formed with representatives from state agencies, regional planning district commissions, soil and water conservation districts (SWCDs), the Interstate Commission on the Potomac River Basin, the Shenandoah Valley Pure Water 2000 Forum and the Virginia Cooperative Extension. This steering committee established the process and direction for the Interim Nutrient Cap Strategy. Its members include:

Mary Apostolico	Department of Conservation and Recreation
Marc Aveni	Virginia Cooperative Extension
Melvin Bellinger	Potomac Council/Potomac Roundtable - Prince William SWCD
Karl Berger	Metropolitan Washington Council of Governments
Robert Bricker	Shenandoah Valley Pure Water 2000 Forum
David Bulova	Northern Virginia Regional Commission
Michael Carolan	Department of Environmental Quality
Tom Christoffel	Lord Fairfax Planning District Commission
Moira Croghan	Department of Conservation and Recreation
Greg Evans	Potomac Council/Potomac Roundtable - Northern Virginia SWCD
Tom Faha	Department of Environmental Quality
John Giles	Central Shenandoah Valley Planning District Commission
Norman Goulet	Northern Virginia Regional Commission
Carlton Haywood	Interstate Commission on the Potomac River Basin
Karen Henderson	Rappahannock-Rapidan Regional Commission
Steve Manster	RADCO Regional Commission
Shepard Moon	Chesapeake Bay Local Assistance Program
Stuart McKenzie	Northern Neck Regional Commission
Ronald Phillips	Department of Environmental Quality
Collin Powers	Department of Environmental Quality
Charlie Wade	Department of Conservation and Recreation
Gary Waugh	Department of Conservation and Recreation

This group determined that the Interim Nutrient Cap Strategy would be best developed through a very localized approach. During early meetings, the steering

committee set in motion a process for involving local officials and local representatives. It developed a plan for initial meetings and involvement of local officials, stakeholders and various interested groups.

In each of the three major regions of the watershed (Northern Neck, Northern Virginia and the Shenandoah Valley), kick-off meetings were held with local elected officials (local governments and soil and water conservation district directors). Invitations came from Virginia Secretary of Natural Resources, John Paul Woodley, Jr., and attendance was high.

These elected officials designated staff to attend local focus group meetings, designed to address and answer ten very specific questions on the status of nutrient reductions and directions/opportunities for the interim cap strategy. Ten local focus group meetings were held with local staff across the Shenandoah-Potomac basin. The same ten questions were used at all meetings so that answers and results would be comparable. The list of questions and a complete digest of concerns and issues raised in these meetings can be found in Appendix A.

In addition, three meetings were held in October 2000 to garner input and feedback from community watershed and environmental groups, agricultural interest groups and business associations. Input from these meetings was summarized and has helped to guide strategy development.

In the fall of 2000, this process was then enhanced with the formation of the Potomac Watershed Roundtable. The Roundtable was designed to bring a wide range of local officials, citizens and stakeholders together to address water quality issues, particularly those stemming from nonpoint sources, and to solve problems on a basin-wide basis. The Roundtable has identified the Interim Nutrient Cap Strategy as a major issue for the Potomac watershed and this group will be integrally involved in helping to identify and implement solutions for maintaining the nutrient cap in the watershed.

Throughout this process, discussions have been held with Bay Program partners to identify technical approaches and elements that could be shared among Virginia and Maryland nutrient cap strategies to provide a more comprehensive approach to managing Potomac nutrient loads. Virginia team members will continue to work with their Bay Program partners to identify appropriate shared elements of nutrient cap strategies.

Major Messages Heard at Local Meetings

A number of major messages surfaced from the public as a result of meetings held throughout the Shenandoah-Potomac basin. These messages are briefly outlined below in order to frame some of the important concepts that affect decisions on the final form and development of a nutrient cap strategy. A more detailed listing of concerns and themes is found in Appendix A.

General Program Design and Development

- Funding for cost-share and incentive programs is key to success of the Interim Nutrient Cap Strategy.
- Expanded information and public education on the benefits of water quality initiatives will be necessary to achieve continued nutrient reductions.
- Recognition (and value) of the local and regional side of water quality issues is important.
- Equitable allocation of nutrient loads across the basin in the face of diverse economies, population pressures and timing of growth will be a challenge.
- Empower local governments to accomplish the tasks that the state asks of them.

Implementation Issues

- Support of innovative solutions for managing all types of nutrient sources.
- Managing urban stormwater runoff is our biggest implementation challenge, as well as our biggest opportunity for further nutrient reductions.
- Managing nutrient loads from septic tanks.
- State and local governments should encourage and/or require options for managing runoff from ultra-urban areas.
- "Low-impact" development practices should be encouraged and/or required.
- Need to increase awareness of how standard local programs and planning practices (i.e., open space requirements) have nutrient reduction benefits.
- Enhancing urban, suburban and agricultural nutrient management planning, with particular emphasis on urban and suburban (lawn care) opportunities.
- Point source infiltration/inflow problems need to be addressed.
- Restoration of riparian areas is very important for nutrient reductions. The Conservation Reserve Enhancement Program needs to be further marketed to farmers.
- Further growth in the Shenandoah-Potomac basin should be channeled to areas that are served by a service authority.

Tracking and Accounting

- Our ability to track nutrient load increases, offsets and reductions will profoundly affect the design of a nutrient cap program in the Shenandoah-Potomac basin.
- While the Chesapeake Bay Computer Model is useful for tracking basin-wide loads and reductions, it does not have sufficient resolution to support a locally based nutrient cap program.
- Water Quality Monitoring should be used in conjunction with any tracking system in order to evaluate long-term success of nutrient reduction efforts.
- Local or regional tracking systems (or programs) should be based on a consistent and effective state model.
- Local and state agencies should continue to work toward tracking and accounting for voluntary nutrient reduction practices and programs.

III. Progress of the Shenandoah and Potomac Tributary Strategy

This section addresses the progress to date on the nutrient reduction goals of the Shenandoah and Potomac Tributary Strategy for point and nonpoint sources in the basin. Brief descriptions of some of the actions and programs that were instrumental in this progress are included with expanded technical discussion provided in Appendix B on two selected topics. Some lessons learned from the Shenandoah and Potomac Strategy are outlined at the end of this section.

A. Point Source Implementation

The combined nutrient reduction goal for point sources and nonpoint sources in the Shenandoah-Potomac basin is 40 percent for both nitrogen and phosphorus. Assignments of nutrient reduction targets specific to either point sources or nonpoint sources have not been made. However, for the sake of clarity, the following descriptions of goal attainment progress assume that 40 percent target reductions for both point source and nonpoint source nutrient loads would be expected to meet the combined 40 percent goal.

In the period between 1985 and 1999 the phosphorus load delivered to the Chesapeake Bay from point sources in Virginia's portion of the Shenandoah-Potomac basin has decreased by 249,000 pounds per year. This equates to a 48 percent reduction from the 1985 baseline point source loading estimate, and this achievement surpasses the original reduction goal by 8 percent. The use of chemical phosphorus removal technology at several major wastewater treatment facilities in Northern Virginia and the enactment of the phosphate detergent ban were primarily responsible for this success.

In the same time period, the nitrogen load delivered to the Bay from point sources in Virginia's portion of the Shenandoah-Potomac basin has increased by only 8 percent (751,000 pounds per year) **even though basin-wide wastewater flows have increased by 22 percent.** Population growth is sure to present a serious challenge to goal attainment in all of the bay's river basins. However, the point source facilities within Virginia's portion of the Shenandoah-Potomac basin have already taken significant steps towards goal attainment despite these flow increases. The installation of Biological Nutrient Removal (BNR) technology at several wastewater treatment plants within the basin is already underway. Projections of nutrient reductions from these current projects promise to deliver the basin extremely close to the 40 percent nitrogen reduction goal.

BNR is a treatment process that reduces nitrogen and phosphorus from wastewater treatment plant discharges. This process has been shown to be adaptable to several existing sewage treatment types. BNR treatment systems can reduce total nitrogen concentrations in the effluent from an average between 19 and 20 mg/L to 8.0 mg/L or less. Similarly, these treatment systems can reduce phosphorus concentrations in the

treated effluent from 2.5 mg/L to 1.5 mg/L. A brief description of this process and some of its advantages can be found in Appendix B of this document.

Virginia's Water Quality Improvement Fund (WQIF) has been an effective instrument to entice the commitments necessary to close in on nutrient reduction goals. The Virginia General Assembly instituted the WQIF in conjunction with the 1997 passage of the Virginia Water Quality Improvement Act. This fund enables the Commonwealth to provide financial and technical assistance to local governments, businesses, and individuals for reductions of point source and nonpoint source nutrient loads to the bay.

The WQIF is one of two different sources for the technical assistance related to BNR retrofit evaluations. Larger treatment plants may be eligible for WQIF Technical Assistance Grants to help defray the costs associated with these very complex evaluations. Smaller plants may benefit from a no-cost retrofit evaluation conducted by Virginia Polytechnic Institute & State University through funds made available by the federal-interstate Chesapeake Bay Program. The feasibility of retrofitting wastewater treatment plants with BNR is studied, as are process improvements and pollution prevention opportunities that may optimize a plant's nutrient removal efficiency. Over the course of the evaluation, a thorough inspection of the entire treatment facility and discharge monitoring records is conducted. The critical design and operational parameters are identified for Biological Nutrient Removal. Opportunities for process modifications are investigated and described in detail. A final report is drafted, outlining recommendations, modification costs and nutrient loading reduction estimates. To date, 24 plants in the Virginia Shenandoah-Potomac basin have been analyzed for BNR retrofit and the owners provided with very useful information about this type of treatment at their plants.

Under provisions in the Water Quality Improvement Act, WQIF funding can be made available to finance at least 50 percent of the design and installation costs of nutrient reduction technologies. Eligible recipients include publicly owned municipal wastewater treatment facilities proposing to install nutrient control systems. All WQIF grants are governed by a legally binding, enforceable agreement. The agreement contains provisions to govern the design and installation of facility upgrades. The agreement also spells out long-term operation, maintenance, monitoring and reporting requirements as well as stipulated penalties for non-performance.

Three of the thirty-four (34) significant point sources in the Shenandoah-Potomac basin currently operate using BNR, two of which received cost-share assistance from the WQIF. Of the three BNR plants, only two had BNR online before the latest available set of data was collected to monitor total nitrogen and total phosphorus loading in the river basin. These two plants accounted for a net decrease of 40,450 pounds/year of total nitrogen discharged and 1,900 pounds/year of total phosphorus discharged between 1985 and 1999. Sixteen additional point sources are receiving WQIF grant funding for nutrient reduction projects currently still under construction. Twelve of these point sources are undergoing BNR installation while the other four are receiving grant assistance for a land

application project that has the potential to completely eliminate their discharges. In all, there are seventeen separate WQIF grant agreements that have been signed in the Shenandoah-Potomac basin. These projects account for about $71.4 million in state cost-share, with just over $35.5 million reimbursed to-date for work accomplished. Details on these projects are shown included in Table 2.

Table 2. Status of Point Source WQIF Projects in the Shenandoah-Potomac Basin

Facility	Grant Amount	Size (MGD)	Status
Stafford Co.-Aquia	$351,962	6.0	**BNR on-line** ('99 TN=5.56 mg/l)
Fred/Win SA-Opequon	$2,828,963	8.4	**Construction complete**
Harr/Rock RSA-N. River	$2,871,547	16.0	**Construction complete**
SIL Clean Water	$546,000	N/A	**Design completed**
SIL Clean Water	$1,983,890	1.92	**Construction complete**
Fairfax-Blue Plains	$1,387,500	31.0	28% paid; **BNR retrofit complete**
Loudoun Co. SA-Bl. Plains	$365,500	13.8	45% paid; **BNR retrofit complete**
Leesburg	$6,477,734	4.85	BNR about 48% complete
Stuanton-Middle River	$1,299,433	6.8	BNR about 40% complete
Arlington Co.	$10,816,973	40.0	Flow Equalization built; adding BNR
Fairfax Co.-Noman Cole	$10,399,500	67.0	BNR about 35% complete
Pr. Wm. Co. SA-Mooney	$4,879,250	18.0	Phase 1 about 30% complete
Alexandria SA	$20,147,914	54.0	BNR system 25% complete
Purcellville	$1,604,654	1.0	Construction started 7/24
Dale Service Corp. #1	$1,901,057	4.0	Construction began early 8/00
Dale Service Corp. #8	$2,115,053	4.3	Construction began early 8/00
Augusta C. SA-St. Draft	$1,424,724	2.5	Construction started 8/7/00

The projects still under construction are scheduled to be completed by spring 2002, with several starting their BNR operation in the coming year. Notable actions that have occurred since the 1999 Tributary Strategies Annual Progress Report include:

- SIL Clean Water signed a $1,983,890 grant agreement for construction of their Modular Reclamation Reuse System (MRRS) in Rockingham County. The MRRS went into service in September 2000, taking four existing plants offline–the Towns of Timberville and Broadway, and two poultry producers, Wampler and Rocco Foods. The MRRS has a VPDES permit that allows for a combination of

surface water discharge and land application. Depending on the amount of treated flow used in irrigation, this project has the potential to significantly reduce (and possibly eliminate) the discharge of nutrients into the North Fork Shenandoah River from the four plants.

- The Stafford County-Aquia plant became the first to report on annual average nitrogen levels under their grant agreement. For calendar year 1999, the annual average TN discharge concentration was 5.56 mg/l, which is better than their performance requirement of 8 mg/l.

Assuming 1999 flows, the completion of the current WQIF projects is expected to result in nitrogen discharge load reductions of 4.2 million pounds per year (equivalent to a 3.9 million-pound per year reduction in the nitrogen load delivered to the bay) relative to the 1985 baseline. [See Appendix B of this document for a discussion about the difference between discharged and delivered loads.] This would represent a 39 percent reduction in the total discharged nitrogen load (**or a 42 percent reduction in the nitrogen load delivered to the bay**) from the significant point sources in Virginia's portion of the Shenandoah-Potomac basin. Under the same scenario, the total phosphorus load discharged from point sources would be reduced by 367,000 pounds per year (a 284,000 pound per year reduction in the phosphorus load delivered to the bay). When compared to 1985 point source discharge loads, the overall decrease of the phosphorus load from point sources would be 53 percent (or a 54 percent reduction in the point source phosphorus load delivered to the bay). These accomplishments and expectations are summarized in Table 3.

Table 3. Expected Point Source Nutrient Loading Subsequent to WQIF Project Completion

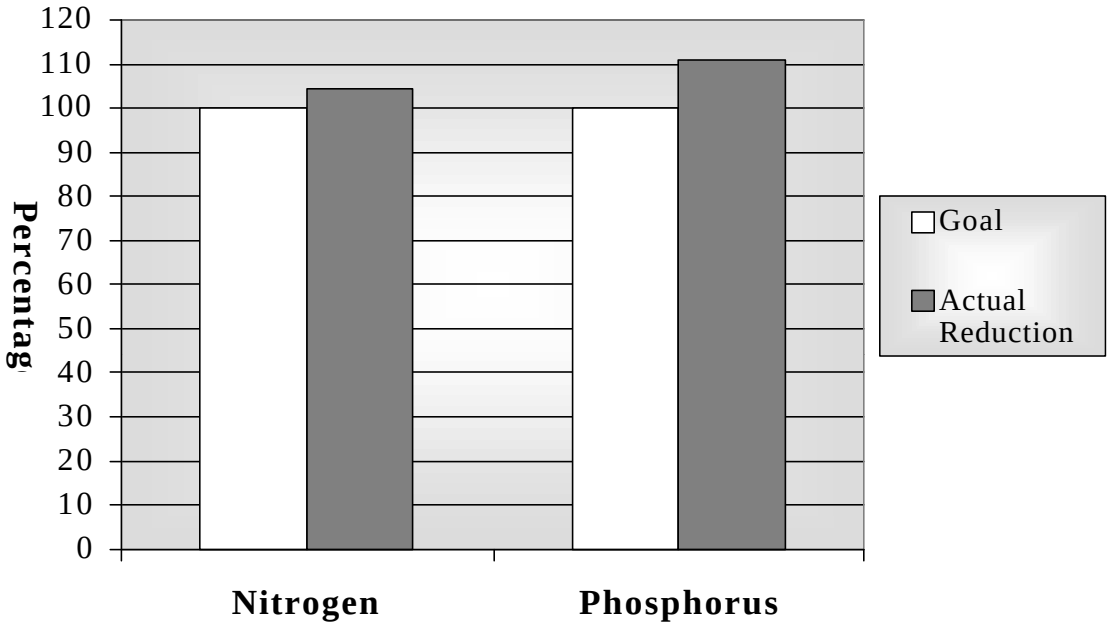
FACILITY	WQIF Project (Y/N)	Total Nitrogen Load (lbs/yr)			Total Phosphorus Load (lbs/yr)		
		1985	1999	Current WQIF Online	1985	1999	Current WQIF Online
Aquia STP	Yes	64,890	54,100	54,100	2,050	810	810
Quantico-Mainside STP	No	82,540	52,880	52,880	880	220	220
Alexandria STP	Yes	1,994,010	2,796,130	861,359	16,260	4,240	4,240
Arlington STP	Yes	1,641,280	918,570	659,474	46,890	7,530	7,530
ACSA-Stuarts Draft STP	Yes	28,460	36,120	18,752	9,740	5,560	3,516
Blue Plains - VA Portion	Yes	814,170	1,262,350	844,555	6,850	15,840	15,840
Noman Cole STP	Yes	2,225,840	2,210,180	1,013,320	30,090	11,370	11,370
FWSA-Opequon STP	Yes	226,560	274,660	125,173	77,540	34,100	23,470
Leesburg	Yes	71,730	162,840	61,856	2,570	10,850	10,850
Purcellville	Yes	15,370	18,540	8,036	5,260	2,480	1,507
Dale Serv. Corp. #1	Yes	91,320	89,620	54,307	1,100	800	800
Dale Serv. Corp. #8	Yes	38,360	96,150	51,141	840	750	750
PWCSA-Mooney STP	Yes	609,160	540,670	214,792	3,690	2,170	2,170
Broadway STP	Yes	14,230	21,060	0	4,870	2,040	0
HRRSA-North River STP	Yes	367,160	437,060	218,688	125,660	60,100	41,004
Rocco Quality Foods	Yes	12,490	26,170	0	14,610	14,610	0
Timberville STP	Yes	5,120	14,770	0	1,750	1,460	0
Wampler-Broadway	Yes	40,580	127,140	0	280	950	0
Staunton-Middle River STP	Yes	162,810	69,030	69,030	55,720	16,440	16,440
ACSA-Fishersville STP	No	44,400	20,080	20,080	15,200	5460	5,460
Upper Occoquan S.A.	No	597,530	1,369,760	1,369,760	860	2920	2,920
Parkins Mill STP	No	0	66,880	66,880	0	8940	8,940
King George-Dahlgren STP	No	5,690	4,800	4,800	1,950	1040	1,040
USNSWC-Dahlgren STP	No	0	17,990	17,990	0	4240	4,240
Luray STP	No	3,380	6,270	6,270	2,930	1710	1,710
Massanutten PSA STP	No	0	24,090	24,090	0	3220	3,220
Merck-Elkton	No	233,880	108,260	108,260	60,580	81140	81,140
Rocco Farm Foods	No	147,310	285,350	285,350	19,090	36970	36,970
Strasburg STP	No	42,120	37,170	37,170	14,420	4970	4,970
Woodstock STP	No	26,760	24,400	24,400	9,160	3260	3,260
Front Royal STP	No	112,140	77,730	77,730	38,380	7740	7,740
DuPont-Waynesboro	No	299,630	38,380	38,380	57,200	1120	1,120
Waynesboro STP	No	190,930	167,220	167,220	48,320	22360	22,360
Colonial Beach STP	No	22,770	35,070	35,070	7,790	6040	6,040
Aileen, Inc.	No	15,960	0	0	13,020	0	0
Avtex Fibers	No	515,200	0	0	3,680	0	0
Total		10,763,780	11,491,490	6,590,913	699,230	383,450	331,647
Change From Baseline (%)			7%	-39%		-45%	-53%

B. Nonpoint Source Implementation

Thanks to the efforts of farmers, local governments, conservation groups and others in the Shenandoah Valley, Northern Virginia and Northern Neck, Virginia surpassed the nonpoint source pollution commitments in the *Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy*. The strategy called for reductions of 3.47 million pounds of nitrogen and 560,000 pounds of phosphorus from nonpoint sources. The Virginia Department of Conservation and Recreation (DCR) tracked reductions from the use of agricultural best management practices (BMPs), nutrient

management planning, erosion and sediment controls and other actions. As of December 31,2000, Virginia had reduced nonpoint source nitrogen by 3.6 million pounds and nearly 620,000 pounds of phosphorus. These accomplishments are illustrated in Figure 1 below.

Figure 1 Shenandoah and Potomac Nutrient Reduction Strategy Nonpoint Source Goal Attainment Through 12/31/2000



The principal nonpoint source components of the strategy included agricultural Best Management Practices (BMPs) and agricultural nutrient management planning. The agricultural BMPs were implemented through Virginia's Agricultural Best Management Practices Cost Share Program administered locally by soil and water conservation districts. Each of the ten SWCDs in the basin was assigned nutrient reduction goals based on a level of BMP installation.

Districts addressed the landowner conservation needs through the continued employment of technical staff aided by $500,000 in annual support funds from the DCR. A total of $15 million was distributed through the Agricultural Best Management Practices Cost Share program to Virginia landowners for the installation of agricultural BMPs. Monies for the technical support and the BMP Cost Share Program came from the Virginia Water Quality Improvement Fund.

Figures 2 and 3 illustrate the relative contributions made by the principal nonpoint sources towards overall nitrogen and phosphorus goal attainment.

Figure 2 **Nonpoint Source Nitrogen Reduction Contributions by Source Category**

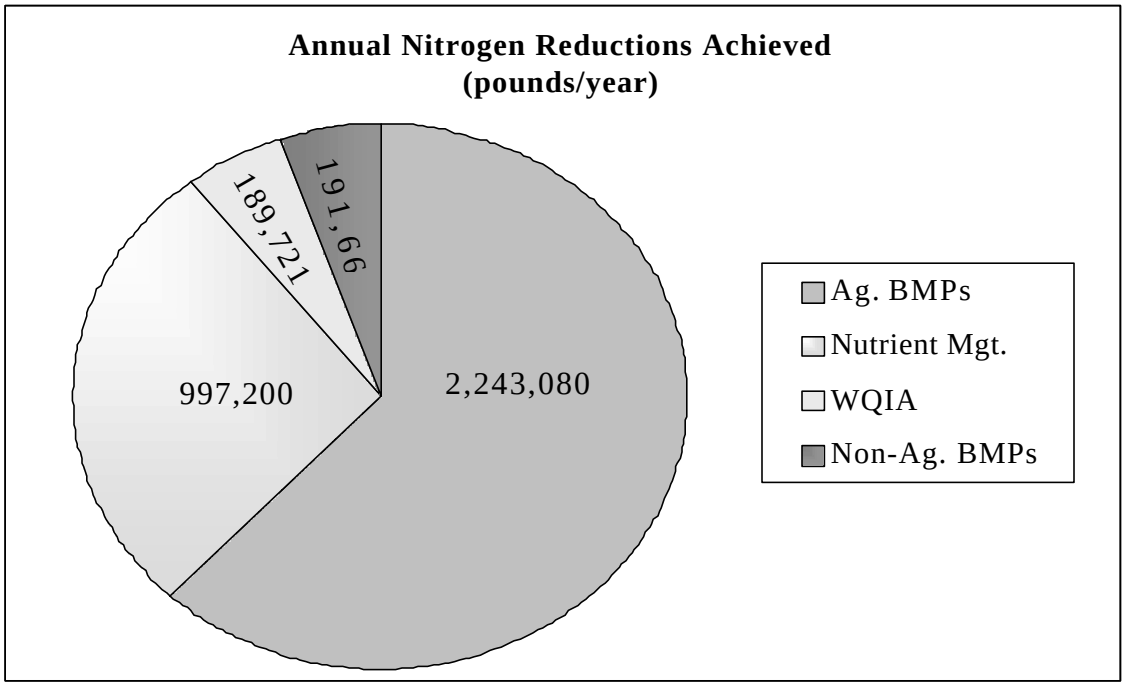
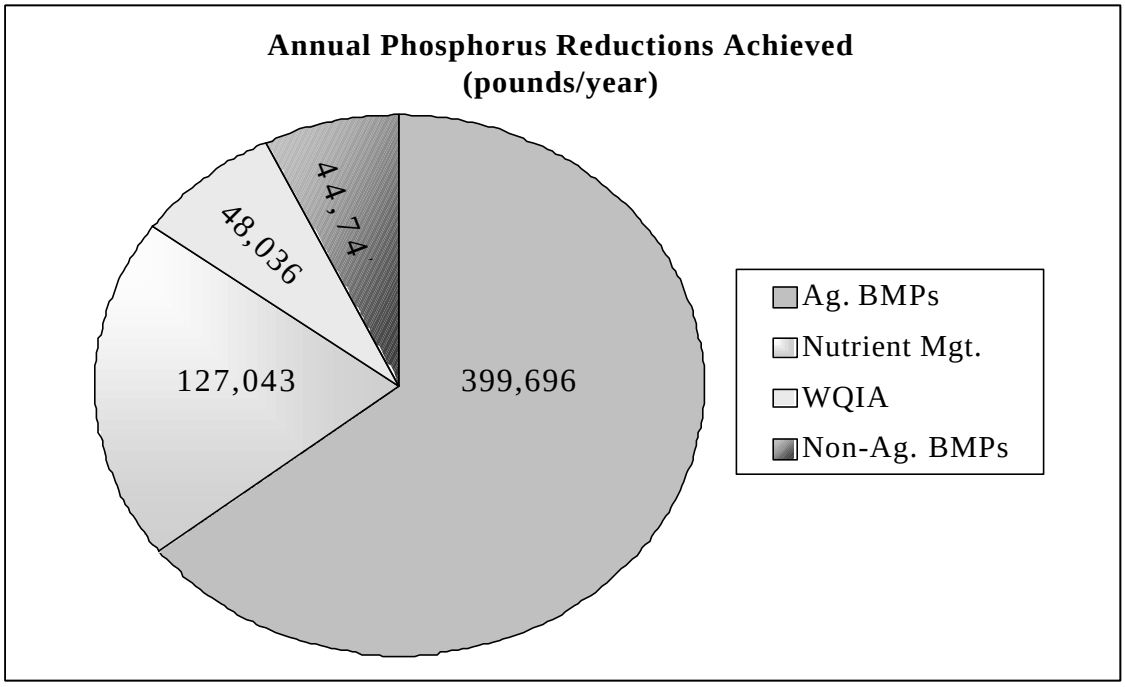


Figure 3 **Nonpoint Source Phosphorus Reduction Contributions by Source Category**



Nutrient Management Planning has been accomplished through the combined efforts of DCR nutrient management staff, local SWCD staff and private certified nutrient management planners. Additionally, in the Shenandoah watershed, two local agribusiness firms were contracted through a Water Quality Improvement Act grant to carry out nutrient management planning. The strategy led to nutrient management plans being implemented on farms that traditionally had not participated in any state or federal conservation programs. Additional demands for nutrient management plans have resulted with the passage of HB 1207, which requires nutrient management plans for poultry producers. There are approximately 280,000 acres with nutrient management plans completed in the Shenandoah-Potomac basin.

As part of the future efforts to reduce nonpoint source nutrient loads in the Shenandoah-Potomac basin, the DCR has worked with local governments and other groups to facilitate the formation of "roundtables" in each of the major river basins.

These roundtables are intended to maintain a long-term level of stakeholder involvement in the Commonwealth's tributary strategy efforts. Watershed Conservation Roundtables provide local stakeholders with an opportunity to take a greater role in participating in watershed-based management and activities. Roundtables around the state provide a watershed-based forum for stakeholders to participate in defining critical needs, targeting problems for solutions, and providing direct input into potential management options. The Shenandoah and Potomac Roundtables provide a critical avenue for cooperative partners and stakeholders to work together to reach consensus on identifying problems, goals, approaches and actions for maintaining the Cap.

Shenandoah Watershed Roundtable – The Shenandoah Valley Pure Water 2000 Forum serves as the roundtable for the Shenandoah watershed. The membership of this organization reflects the interests of business, local government, state and Federal agencies, agriculture and environmental groups. The Pure Water 2000 Forum hosted and facilitated three local focus group meetings for the interim cap strategy process. Additionally, the Pure Water 2000 Forum has partnered with DCR on several educational initiatives.

Potomac Watershed Roundtable- The Potomac Watershed Roundtable was launched at the Potomac Watershed Forum held on August 25, 2000. Nearly 300 local government officials, planners, conservation leaders, agency staff and concerned citizens met to discuss issues of watershed conservation and water quality. The forum was sponsored by the Potomac Council (made up of the six SWCDs in Virginia's portion of the Potomac Watershed, and DCR's Potomac Watershed Manager).

The roundtable seeks to broaden stakeholder participation in the Potomac River Basin, and to raise the overall level of participation. Elected officials, chief administrative and/or environmental officers of local governments, board members of SWCDs, managers of industrial and municipal point sources, regional environmental managers of state agencies, cooperative extension agents, federal government, agribusiness and leaders of community watershed organizations are represented.

The roundtable will discuss ongoing and emerging issues. Early discussions have focused on the current efforts to develop a plan to maintain or "cap" nutrient reductions achieved through the 1996 Shenandoah and Potomac Nutrient Reduction Strategy. Discussions will also focus on how implementation of this interim "Cap Strategy" fits in to the ongoing efforts to remove the tidal portions of the Potomac and the Chesapeake Bay from the federal "impaired waters list."

C. Lessons Learned from the Shenandoah and Potomac Tributary Strategy

Implementation of the 1996 Shenandoah and Potomac Tributary Strategy has provided important lessons for design and development of Virginia's Interim Nutrient Cap Strategy. These include:

- ☞ Offer financial incentives to farmers, wastewater treatment plant operators, local officials and others; and they will do their share toward water quality restoration.

- ☞ The Commonwealth's continued commitment to tributary strategies and the Water Quality Improvement Fund is a key factor in the ultimate success of the tributary strategy program.

- ☞ Conservation practices (in the agricultural sector) only get installed if there is staff to ☛market☚ these practices, assist with grant applications, and provide technical assistance.

- ☞ The best information on the kinds of management practices that may be implemented for nutrient and sediment reductions comes from local stakeholders and local/regional staff. However, these predictions can never be 100 percent accurate; and the strategies must be flexible enough to reflect new and changing opportunities for nutrient and sediment reductions.

- ☞ To obtain stakeholders involvement, it is important to link strategy goals and restoration efforts to local water quality concerns.

- ☞ Some flexibility may be needed in the existing criteria that practices are not eligible under the Water Quality Improvement Fund if they are required by some regulation.

- ☞ It is anticipated that at some point in implementing every strategy, the implementation rate of new conservation practices will level off. The strategy process (and cost-share funding) should not overlook the need for continued education, planning, research, demonstration projects, and innovative conservation systems and incentives.

- A major issue for every strategy is achieving and maintaining reduced nutrient and sediment loads in the face of expected land use changes, and increasing wastewater flows, that result from population increases.

- Efforts must continue to refine and update information on removal rates and cost efficiencies for significant management options. This is particularly important for cost-effectiveness comparisons between point and nonpoint source options.

IV. Point Source Implementation Mechanisms

This section provides descriptions of the actions that need to be undertaken by point source facilities to close in on the nutrient reduction goals of the basin and maintain the reduction goals for the duration of the Interim Nutrient Cap Strategy. This section also addresses some of the issues and challenges that must be resolved prior to the adoption of a final cap strategy.

A. Closing the Gap

The 40 percent nutrient loading reduction goal is shared by both point and nonpoint sources. The assignment of target reduction levels within or between specific point and nonpoint sources has not occurred. For the sake of clarity, however, the following descriptions of point source goal attainment and maintenance strategies assumes that both point and nonpoint sources are expected to reduce their respective loads by 40 percent each.

Sixteen of the thirty-one facilities currently tracked for their nutrient discharge and operating without BNR have received grant approval for nutrient removal projects and are either designing or constructing nutrient removal facilities. These plants are considered "significant" sources of nutrients, as they discharge an annual load of nitrogen or phosphorus equal to or greater than a 500,000-gpd municipal wastewater treatment plant. The expected nutrient reductions from these point sources represent a significant portion of the overall nutrient loading reduction goals of the river basin. In recognition of the substantial financial commitments already made, any additional nutrient reductions that may be necessary to close the gap will be sought from those significant point sources operating without BNR first.

The point source loading that is expected subsequent to current WQIF project completion is described in Table 3. With regard to phosphorus reductions, the 40 percent nutrient reduction goal has already been surpassed—there is no gap. As noted previously, the expectations described were derived assuming 1999 flows. For nitrogen, the load was expected to be 39 percent lower than the discharged load during the baseline year and 42 percent lower than the delivered load during the 1985 baseline year.

The last of the current WQIF projects is due to come online in Spring of 2002, at which time the flows will have increased above 1999 levels due to continued population growth. Using a linear regression of the flow and loading data from point sources within the basin, a 7.5 percent increase in flows has been predicted between 1999 and 2003. At this flow level a shortfall in delivered nitrogen load reductions of 2 percent would be projected. The revised shortfall represents 199,000 pounds per year in delivered nitrogen loads that would be need to be offset to meet the nitrogen reduction goal. Very roughly, a combination of non-BNR facilities with equivalent flows of 7.2 million gallons per day could overcome this shortfall if BNR were provided (this assumes a decrease in nitrogen concentration from 18.7 mg/L to 8.0 mg/L and an average delivery ratio of 0.85). In order

to close the gap these BNR conversions would need to be completed before basin-wide point source flows increased by more than 7.5 percent.

The additional nutrient reductions necessary to close the gap will be sought from those significant point sources that operate without BNR. BNR retrofits will be encouraged throughout Virginia's portion of the Shenandoah-Potomac basin. WQIF technical assistance grants and BNR retrofit evaluations conducted by Virginia Polytechnic and State University will be employed whenever possible. WQIF cost-share grant assistance will be offered wherever possible and subject to the availability of funds for the remaining plants that operate without nutrient removal capability.

B. Maintaining the Cap for the Duration of the Interim Period

The major obstacles to nutrient reduction goal maintenance are population growth within the basin, the continued availability of WQIF assistance, and the ability to optimize BNR performance. With regard to phosphorus reductions, Table 4 below illustrates the relative ease of goal maintenance, even under high growth simulations. When assuming that no additional phosphorus reduction steps are taken beyond the current WQIF project completion, goal maintenance for phosphorus reductions is only threatened when the flow levels of all point sources in the watershed reach their current design capacity (almost a 40 percent increase over 1999 flows). Under that scenario, the phosphorus reduction is projected to be 37 percent, only 3 percent short of the goal. This shortfall represents 15,000 pounds per year in delivered phosphorus loading that would need to be offset to meet the phosphorus reduction goal under the design capacity flow projection. Very roughly, a combination of non-BNR facilities with equivalent flows of 6 million gallons per day could overcome this shortfall if BNR were provided (assumes a decrease in phosphorus concentration from 2.5 mg/L to 1.5 mg/L and an average delivery ratio of 0.85). The BNR retrofits required to close the nitrogen gap would more than compensate for the phosphorus shortfall predicted at this flow level.

Goal maintenance for nitrogen reduction presents a more difficult challenge. By 2003, the expected end of the Interim Nutrient Cap Strategy period, the nitrogen goal is expected to be met or within very close reach. Current forecasts of flow increases within the watershed over the last 14 years suggest an annual flow increase in the range of 1.5 to 2.0 percent per year. Given the lag time associated with the design and construction activities for BNR retrofits and actual BNR reductions (roughly 1.5 to 2.0 years, depending on plant complexity), rigorous pursuit of additional nutrient reductions in the interim period will be essential to short-term and long-term cap maintenance.

According to Table 4 (below), the conversion of all remaining significant point sources to BNR promises to maintain the goal reductions up to just beyond a 15 percent increase in basin-wide flow from point sources. According to the same assumption at the 25 percent flow increase level, the reduction projection falls 2 percent short of the 40 percent goal. The shortfall for this scenario only deteriorates when the flow levels are increased to current basin-wide design capacity. In such case the nitrogen shortfall is projected to be 10 percent. Clearly, even a relatively conservative 15 percent growth

expectation illustrates the need for BNR at the remaining significant point sources. Minimizing and offsetting the impacts of population growth are essential to the elimination of the shortfalls projected from the 25 percent flow increase level and beyond.

Table 4. Point Source Nitrogen and Phosphorus Loading Projections

	Annual Delivered Nitrogen Load (lbs/yr)	Load Change (%)	Annual Delivered Phosphorus Load (lbs/yr)	Load Change (%)
Baseline Year (1985)	9,204,000	NA	523,000	NA
Target	5,522,000	-40%	314,000	-40%
Current Year (1999)	9,955,000	8%	274,000	-48%
Reduction Scenarios Using Current (1999) Flow				
Current WQIF Project Completion	5,337,000	-42%	239,000	-54%
BNR at all Significant Point Sources	4,569,000	-50%	178,000	-66%
Reduction Scenarios Assuming Flow Increase of 15%				
Current WQIF Project Completion	6,138,000	-33%	275,000	-47%
BNR at all Significant Point Sources	5,254,000	-43%	205,000	-61%
Reduction Scenarios Assuming Flow Increase of 25%				
Current WQIF Project Completion	6,672,000	-28%	299,000	-43%
BNR at all Significant Point Sources	5,711,000	-38%	223,000	-57%
Reduction Scenarios Assuming Design Flows				
Current WQIF Project Completion	7,489,000	-19%	329,000	-37%
BNR at all Significant Point Sources	6,424,000	-30%	252,000	-52%

For our purposes, there are a few distinct ways that population growth may affect point source loads. Each must be contended with effectively in order to minimize and offset nutrient load increases above the cap. There are two effects of population growth that relate specifically to existing point source facilities. The first occurs when flows within a point source's service area increase and the treatment plant approaches its design capacity. The second occurs as increased flows require plant expansion for additional design capacity. The effects of population growth on point sources are not limited to existing facilities. Population growth may also result in the construction of brand new point source facilities. Each effect of population growth will be addressed by a different

series of expectations, with a common goal of nutrient cap load maintenance. Refer to Table 5 below for a brief overview.

Table 5. Proposed Point Source Cap Management Approach

	Action	Expectation	Supporting Programs
Existing Source	Increased flows within design capacity	Install BNR (voluntary), optimize nutrient removal technology (voluntary)	WQIF Grant Assistance, Potential Challenge & Incentive Grants
Existing Source	Plant expansion	Install BNR and employ optimal performance nutrient removal technology. Offset any nutrient increase.	WQIF Grant Assistance, Potential Challenge & Incentive Grants
New Source	Proposed discharge from new source	Install BNR and employ optimal performance nutrient removal technology. Offset any nutrient increase.	WQIF Grant Assistance

1. Existing Point Sources, Flow Increase Within Design Capacity

As stated previously, the provision of BNR at all significant point sources will be actively sought prior to requesting additional reductions from active BNR facilities. As the flow increases at existing facilities go beyond 15 percent toward the current design capacity, however, additional reductions will be needed. The reductions expected by the nutrient removal projects underway in the Shenandoah Valley will be held in reserve in anticipation of future growth to current treatment plant design capacity. These nutrient reductions will be reverted back to the appropriate WQIF recipient facilities and localities in lieu of a request for additional nutrient removal. The proposed challenge and incentive grants described in Appendix B would be employed to specifically address these anticipated load increases from the currently active point source facilities.

2. Existing Point Sources, Plant Expansions

As illustrated in Table 4, the expansion of existing point sources beyond their current design capacity represents a serious threat to cap maintenance. The largest wastewater treatment plants in the Shenandoah-Potomac basin either already have BNR or have entered into an agreement with the Commonwealth for WQIF grant assistance for BNR implementation. The installation of BNR at all significant point source facilities is needed to address even modest levels of growth, and, without additional actions, these provisions will not be sufficient to offset growth beyond current design capacity. While the expansion of any non-BNR significant point source should, at a minimum, include the

conversion to BNR treatment, additional reductions would clearly be needed to maintain the cap.

This obstacle is complicated by the fact that smaller sized wastewater treatment facilities (those with design capacities below one-half million gallons per day) operating without BNR represent a lower potential nutrient loading reduction per plant relative to the larger plants. This is partially due to the fact that the nutrient load from each smaller plant is a smaller portion of the total nutrient load of the basin. Design and engineering studies at these plants represent a more significant investment relative to the potential loading decreases. Unless the plant already has flow equalization, the much more variable flow rates at smaller treatment plants tend to be much less amenable to retrofit with the BNR process. Also, the need for more intensive operator control to perform BNR at these plants might require a larger commitment in staffing levels. Given that many of these smaller plants have operator requirements that are less than 24 hours per day, seven days a week, these increased costs may make BNR at such plants an unrealistic expectation. However, in cases where the design capacity of a smaller plant is proposed to expand up to or above the one-half million gallons per day threshold, the provision of BNR would be expected. As in the case with expansions at the significant point source facilities, other nutrient reduction and offsetting measures would be expected. An alternative to expanded operator oversight or significant capital upgrades might be the use of automatic controls for BNR operation.

The optimization of nutrient reductions at expanded BNR facilities should be expected from the outset. The expanded BNR facilities should be expected to consistently achieve nitrogen reductions below the 8 mg/L annual average target. The efficiency of BNR operation at these facilities should be conducted at levels as close to technologically achievable as practical, given the constraints inherent in any process reconfiguration. While the proposed challenge and incentive grants may be made available to expanded BNR facilities, the use of such grants should be targeted primarily towards those facilities operating within their current design flow capacity.

Offsetting measures should be employed to address any nutrient load increases associated with the expansion of a significant point source. In cases where a plant expansion brings one or more existing plants offline, the elimination of the offline loads will be considered in offset calculations. Similar consideration should be afforded to any portion of a plant expansion devoted to septic tank cutovers. The offsetting measures could be implemented by employing any combination of activities that would offset any increase in nitrogen or phosphorus delivered to the bay resulting from plant expansion with at least an equal decrease in nitrogen or phosphorus delivered to the bay. The offsetting measures would have to be performed in the same general locality as the nutrient load increase and documented for load allocation purposes.

3. New Point Sources

The construction of new point source facilities within Virginia's portion of the Shenandoah-Potomac basin presents an equally significant challenge to cap maintenance. Such treatment plants should include the provision of BNR from the outset. The efficiency of BNR operation at these facilities should be conducted at levels as close to technologically achievable as possible. As with the plant expansions described above, offsetting measures should be employed to assure that no net increase in delivered nutrients to the bay occurs. In cases where a new plant brings one or more existing plants offline, the elimination of the offline loads will be considered in offset calculations. Similar consideration should be afforded to the flow portion of a new plant resulting from septic tank cutovers. Again, the offsetting measures would have to be performed in the same general locality as the nutrient load increase and documented for load accounting purposes.

C. Maintaining the Cap for the Final Strategy

The shift from the Interim Nutrient Cap Strategy to the final nutrient cap strategy promises to deliver challenges beyond population growth. Although it is not clear exactly what the new target nutrient loads will be, it is assumed that they will be more challenging than the original strategy's 40 percent reductions. In order for point sources to meet the new reduction targets under continued pressure from population growth, a more formalized approach will be required. Elements of such an approach would need to include a continued emphasis on minimizing and offsetting load increases, the adoption of an equitable load tracking and allocation program and the continued pursuit of technological advances in nutrient removal systems.

Minimizing and offsetting nutrient load increases under a final cap strategy would continue to play an essential role in cap maintenance. The effectiveness of the management system described in Table 5 above could be greatly enhanced if Virginia adopted a nutrient-trading program. The Interstate Chesapeake Bay Program has prepared preliminary guidance for the adoption of such a program that, fundamentally, involves the buying and selling of nutrient reduction credits (see Appendix C for more information). Besides the ability to offset growth, other potential advantages of a nutrient trading program include increased nutrient reductions, the hastening of such reductions, the maximization of the reductions per dollar and incentives for technological innovation. No such program currently exists in Virginia. However, in light of the challenges posed by population growth in the basin, the potential benefits of such a program certainly merit consideration.

The development of an equitable load tracking and allocation program will be critical to cap maintenance as the stock of available implementation remedies becomes diminished. The development of an allocation program would allow the assignment of nutrient cap loads in some form or fashion (locally, regionally, by source type category or other). A more thorough discussion of this topic is provided in Section VI of this document. In short, however, the overriding goal of such a program would be to provide

clear lines of responsibility, accountability and equity—all necessary ingredients for cap strategy success.

As nutrient reduction technology advances so will the expectation to implement such technology to achieve any additional nutrient reductions necessary to maintain the cap. Point sources will be expected to play their part to meet lower and lower nutrient target levels, and the use of BNR or other nutrient reduction technologies will be expected at smaller and smaller treatment plants. Where the technology exists and can be applied practically, no nutrient reduction option will be ignored.

Table 6 (below) may be useful to illustrate the potential to meet future growth challenges in the basin. Two different scenarios were subjected to four different flow projections. The first scenario, “BNR at all Significant Point Sources at Optimal Efficiency”, assumes all active significant point sources have implemented BNR and operate with “optimal nutrient removal." For the sake of this discussion “optimal nutrient removal” is assumed to mean that the annual average TN concentration has been decreased to 5.5 mg/L, and the annual average TP concentration has been decreased to 0.18 mg/L. The second scenario, “Nutrient removal at all Significant Point Sources at LOT,” assumes that all significant point sources apply nutrient removal technologies at the “Limits of Technology.” For the sake of this discussion this means that TN discharges are reduced to an annual average of 3.0 mg/L and TP is reduced to an annual average of 0.075 mg/L.

Table 6. Point Source Nitrogen and Phosphorus Loading Projections Under "Optimal Efficiency" & "LOT" Nutrient Reduction Scenarios

	Annual Delivered Nitrogen Load (lbs/yr)	Load Change (%)	Annual Delivered Phosphorus Load (lbs/yr)	Load Change (%)
Baseline Year (1985)	9,204,000	NA	523,000	NA
Target	5,522,000	-40%	314,000	-40%
Reduction Scenarios Using Current (1999) Flow				
BNR at all Significant Point Sources at Optimal Efficiency	3,241,000	-65%	70,000	-87%
Nutrient Removal at all Significant Point Sources at LOT	1,794,000	-81%	47,000	-91%
Reduction Scenarios Assuming Flow Increase of 15%				
BNR at all Significant Point Sources at Optimal Efficiency	3,728,000	-59%	81,000	-85%
Nutrient Removal at all Significant Point Sources at LOT	2,064,000	-78%	54,000	-90%
Reduction Scenarios Assuming Flow Increase of 25%				
BNR at all Significant Point Sources at Optimal Efficiency	4,052,000	-56%	88,000	-83%
Nutrient Removal at all Significant Point Sources at LOT	2,243,000	-76%	59,000	-89%
Reduction Scenarios Assuming Design Flows (~40% Increase)				
BNR at all Significant Point Sources at Optimal Efficiency	4,561,000	-50%	97,000	-81%
Nutrient Removal at all Significant Point Sources at LOT	2,517,000	-73%	65,000	-88%

According to this table (at least with regard to the point source contribution to the basin-wide nutrient reduction goals), the operation of BNR consistently at or below 5.5 mg/L would provide a 10 percent cushion in cap maintenance up to the current design capacity of all active significant point sources. Without discounting the monumental investment that would likely be required to bring about such a scenario, the potential nutrient reductions described above underscore the importance of technological advances as they relate to cap maintenance and continued basin population growth.

V. Nonpoint Source Implementation Mechanisms

As noted earlier, Virginia was able to meet the nonpoint source portion of the tributary strategy commitments. The strategy called for reducing nitrogen by 3,454,512 pounds and phosphorus by 561,441 pounds. As of December 31, 2000, Virginia had reduced nonpoint source nitrogen loads by 3.6 million pounds and phosphorus loads by 619,000 pounds. While these reductions surpassed the commitments set forth in the tributary strategy, they fall just short of a 40 percent reduction.

The nonpoint source 40 percent nitrogen goal is 4.1 million pounds leaving a nitrogen gap of approximately 500,000 pounds. The phosphorus reduction achieved is roughly 3,400 pounds short of the 624,400-pound reduction that would be needed to achieve a 40 percent phosphorus reduction from nonpoint sources. However, continuing the current rate of implementation should close this gap.

A. Maintaining the Cap for the Duration of Interim Period

A significant portion of the non-point nutrient reduction in the original Shenandoah and Potomac Tributary Strategy came from agricultural BMPs implemented through the local soil and water conservation districts. Nutrient management plans also contributed a large part of the nutrient reduction goal. While important reductions must still be achieved through continuing and enhancing these practices, maintaining reductions in the face of increasing population and landscape changes will only be accomplished by shifting the emphasis to areas other than agriculture.

This interim cap strategy will identify reduction options in six major activity categories. The general categories are managing stormwater runoff, outreach and public education, urban nutrient management, on-site wastewater treatment, agriculture and shoreline erosion and protection. *The options are those mentioned in the public comment, focus group process.*

The policies and practices proven instrumental to the success in meeting the original nutrient reduction goals must continue to be pursued and must be fortified with new policies and practices in order to meet the challenges presented by continued population growth and land use changes. The reduction categories are presented in an order reflecting needs for new programmatic attention and development. The areas where the nonpoint source control experience is more limited are presented as the highest priority. Increasing nutrient loads must be reduced to maintain current levels. The recommendations are presented briefly in all six categories. Further discussions of each recommendation are presented in the sections that follow.

1. Recommendations

a. Managing Stormwater Runoff

- Expand the implementation of currently identified and accepted stormwater management and urban BMPs to all localities through the adoption of the Virginia Stormwater Management Regulations Water Quality Technology-based criteria on a jurisdiction wide basis.
- Fully consistent local Erosion and Sediment Control Programs, Stormwater Control Programs and Chesapeake Bay Programs will need to be the standard for all communities.
- Continue to investigate potential new BMPs and evaluate nutrient reduction and tracking information for incorporation into model.
- Review the ESC and SWM Laws and Regulations for opportunities to clarify inspection, maintenance, and enforcement procedures, roles and responsibilities relating to the effective implementation of local and state programs.
- Identify status and coverage of all existing SWM systems, what areas are treated to what level, where are gaps, (GIS data base)
- Develop a Better Site Design training program for county and municipal planners in the watershed using CBLAD's Better Site Design assessment document and workshops.
- Develop model low impact development guidance and distribute to localities in the watershed.
- Give localities that adopt low impact development ordinances priority consideration for all Water Quality Improvement funds or other state water quality related grants or loan programs.
- Work with the Virginia Department of Economic Development to provide businesses located or relocating in the watershed financial incentives for incorporating better site design or low impact development principles in their facilities.

b. Outreach and Public Education

- Work to promote the understanding of individual responsibility and promote a conservation ethic
- Initiate a paid multimedia campaign (television, radio, newspapers, etc.) in the major media markets in the watershed geared to urban, suburban, residential land owners
- Seek partnerships with Washington, D.C., Maryland and the Chesapeake Bay Program for media purchases in the Washington, D.C. market
- Develop a fulfillment component to the media campaign (toll-free hotline, fulfillment brochures, internet)
- Enhance existing "hands on" opportunities to interact with landowners
- Evaluate outreach affects and determine actual nutrient reductions

c. Urban Nutrient Management

- Develop and fully implement urban nutrient management program strategies to include:
  - ⇒ nutrient management plans for golf courses, public and private lands
  - ⇒ modification of state Nutrient Management Training and Certification program to include urban criteria
- Develop a framework for public and private land owners to use in a land maintenance contract which provides sample language to address nutrient management
- Promote and support of Virginia Cooperative Extension's Home Gardener Program
- Educate contractors on the safe use of deicers
- Investigate and encourage pelletizing biosolids into an acceptable consumer product
- Promote environmentally sensitive labeling for fertilizers and deicers
- Promote greater awareness among the general public as well as enforcement of pet waste regulations and maintenance

d. On-site wastewater treatment

- Promote and support citizen education programs currently being developed to raise awareness of karst and the appropriate use of BMPs in the vicinity of sinkholes and limestone outcrops
- Enhance homeowner education emphasizing the need for septic system inspection and pump-out. Also increase awareness about materials that should not be put into any type of wastewater treatment system,
- Promote a local sponsor for the State Revolving Loan Fund for on-site systems
- Offer cost-share for repair or replacement of failing/malfunctioning systems

e. Agriculture

- Continue implementation of BMPs currently funded under the Virginia's Agricultural Cost Share Program.
- Continue Nutrient Management Program with both private and public certified planners
- Promote grazing land protection practices and manure management practices for the horse industry
- Actively Promote the Conservation Reserve Enhancement Program
- Develop a program to maintain and/or replace agricultural BMPs to assure they continue to provide reductions.

f. Shoreline Erosion and Protection

- Initiate tracking of shoreline protection measures on the tidal Potomac and its major tributaries north of King George County.

- Establish a 50 percent cost-share program for properly designed and installed shoreline erosion control measures. Cost-share would be available for agricultural and residential landowners.

2. Discussion

a. Managing Stormwater Runoff

The single most important problem and opportunity for nutrient reductions and water quality improvement is the effective management of stormwater and the design/construction of methods and facilities that effectively process or retain nutrients. Essential to this are programs for operation and maintenance that ensure these systems continue to function and do not create safety hazards or other concerns. A matter of increasing concern is the impact of highly urbanized areas.

The following are the most common BMPs utilized to manage stormwater runoff in urban areas and their respective phosphorus removal efficiencies outlined in the Virginia Stormwater Management Regulations (see table 7). Brief descriptions of these BMPs and the associated maintenance considerations can be found in the *Virginia Stormwater Management Handbook*.

Table 7. Target Removal Efficiencies of Typical Urban BMPs

Water Quality BMP	Target Phosphorus Removal Efficiency	Percent Impervious cover
Vegetated filter strip	10%	16-21%
Grassed Swale	15%	
Constructed wetlands	30%	22-37%
Extended detention (2 X WQ Vol)	35%	
Retention basin I (3 X WQ Vol)	40%	
Bioretention basin	50%	38-66%
Bioretention filter	50%	
Enhanced extended detention	50%	
Retention basin II (4 X WQ Vol)	50%	
Infiltration (1 X WQ Vol)	50%	
Sand filter	65%	67%-100%
Infiltration (2 X WQ Vol)	65%	
Retention basin III (4 X WQ Vol w/ aquatic bench)	65%	

Source: Virginia Stormwater Management Regulations 4VAC3-20, effective March 1998

A combination of factors has resulted in increased interest of an even wider array of BMPs to serve the needs of the ultra-urban environment. Although there are a number of experimental and non-standard BMPs, the primary techniques currently under consideration can be found in Appendix D under the heading: “Green Rooftops”; “Manufactured Stormwater BMP Systems”; and “High Efficiency Street Sweeping”.

An important fact to understand when discussing the management of nonpoint source pollution within an urbanizing watershed is that even the most effective Best Management Practices (BMPs) controlling 100 percent of the landscape will still result in a net increase in pollutant load. This is compounded by the reality that in many cases there are physical limitations on utilizing the “best” BMP, meaning that less than ideal reductions are achieved.

Another fact is that many localities within the Shenandoah-Potomac watershed do not require any stormwater quality BMPs on new development since the adoption of a local comprehensive stormwater management program is optional in most (lower populated) parts of Virginia. Tidewater Virginia localities, defined as those localities that are located east of the fall line, are required to adopt a Chesapeake Bay Preservation Act (CBPA) ordinance. The CBPA ordinances require water quality BMPs in conjunction with the development of designated lands (based on soil, topography, and other physical features) within their jurisdiction. Any development outside of those designated lands typically occurs with no water quality provisions. Some localities, however, have chosen to designate their entire jurisdiction and therefore require stormwater BMPs on all new development. It should be noted that pollutant removal requirements in CBPA zones are based on meeting an average land cover condition. In some cases his allows a significant level of development before any stormwater BMPs are required. In contrast to this, localities within the Occoquan watershed in Northern Virginia are required to use BMPs to control nonpoint source pollution as a means of protecting the drinking water supply. Developers within the Occoquan watershed must meet a single post-development phosphorus removal requirement of up to 50 percent, regardless of average land cover condition. Appendix E contains an overview of the role of the CBPA in capping nutrients. This appendix also contains a discussion of how *better site design* and *low impact development* practices can reduce nutrient loading.

The effectiveness of state and local Erosion and Sediment Control (ESC) programs at reducing nutrient and sediment loads to the Shenandoah and Potomac rivers is limited by the effectiveness of the individual temporary ESC practices implemented on construction sites, and the ability of the local and state personnel to enforce the provisions of the Law and Regulations.

b. Outreach and Public Education

(i) Overview

The success of the 1*996 Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy* is mostly the result of comprehensive cost-share funding for agricultural and forest lands and for wastewater treatment plant upgrades.

As previously stated, in order to maintain this current level of nonpoint source nutrient reductions, Virginia must go beyond agricultural BMPs. Greater reductions can be achieved through efforts to promote sound nutrient management practices on non-agricultural lands and greater emphasis on septic systems.

Currently there are 846,705 acres classified as urban or non-agricultural open lands. This is nearly 24 percent of the land base in the Shenandoah-Potomac watershed that have received minimal attention. Combined with nitrogen loads for septic systems, these lands are estimated to account for annual loads of 6,115,104 pounds nitrogen, 688,768 pounds phosphorus and 114,025 tons sediment.

Some reductions have been achieved from these lands and septic systems through demonstration projects and other localized initiatives funded through the special projects portion of the Water Quality Improvement Fund. However, they have not been dealt with in the same systematic way, as have agricultural and forested lands. Because of the practices necessary and the huge number of landowners involved, these lands do not lend themselves to the use of cost-share such as the one in place reaching farmers and other agricultural landowners.

Dealing with these lands and the septic concerns in a comprehensive, systematic manner will require a strong public education and outreach component to reach the hundreds of thousands of landowners and land managers in the watersheds. Stakeholders have long called for such a campaign. However, for the first time we are hearing stakeholders express a need for this outreach campaign, even if it is funded by diverting funds from traditional “on-the-ground” practices.

The results of the local focus group meetings found a gap that exists in the information and education component that is a natural and indispensable part of watershed restoration. Focus groups in the Shenandoah Valley felt the educational campaign should be focused primarily on the urban, suburban landowner or manager. Focus groups in the Potomac felt while the focus should be on urban and suburban dwellers; the agricultural community could also benefit.

All agree that watershed stakeholders, on the whole, are not informed enough to be aware of their individual land-use effects on water quality. As many stakeholders are not aware of the alternatives available to them at little or no expense, an innovative public information concept is a necessary component to the adjustment of their mind-set, bringing them into the decision making process. This would make available information

and offer concrete reasons for them to implement actions on their own land to improve quality of the water.

(ii) Elements of a Public Education and Outreach Campaign

An effective public education component of the Interim Nutrient Cap Strategy could include the following elements:

The commitment to fund a targeted mass media campaign including the purchase of print and radio/television advertising to run primarily in the Washington, D.C. media market. Maintaining nutrient reductions will require a change in the behavior and habits of residents in the watershed. This cannot be achieved without reaching them with repetitive messages on how to change and, more importantly, why the change will be beneficial to them. A comprehensive campaign employing television, radio, newspapers, mass transit signage and other tools will be necessary. Non-controversial messages featuring a mix of stewardship messages and tips on changing behavior would be featured.

This type of campaign has not been done before because of the cost involved. Purchasing media in the Washington D.C. market is expensive. However, since this is not an exclusive Virginia market the state should explore funding partnerships with Maryland, D.C. and the Chesapeake Bay Program Office. Because of the public service nature of the message the state should also approach organizations such as state and regional broadcasters' associations, the National Advertising Council and Radio Advertising Bureau to develop partnership opportunities.

Exposing stakeholders to the message is only one part of the solution. In the past, campaigns encouraging people to recycle have been cited as a leading reason in getting people to change their behavior to improve their environment. While repeatedly exposing lawmakers and citizens to recycling messages was key to this success, it didn't become a common practice until systems were put in place that made recycling easy.

Advertising alone can not provide information needed for people to act on a call to action. Appropriate programs must be designed and put into place to ensure proper implementation of the message. To provide more information to average citizens on how they can improve water quality, advertisements should reference a toll-free number. Callers would then receive an informational packet on ways they can positively impact water quality in their area.

A toll-free number already exists that could be used for this initiative (1-877-42-WATER). Funding would be needed to handle calls and fulfillment. New collateral materials may need to be developed. Agencies such as DCR, DEQ, and VCE already have pieces that may be incorporated into these packets, but larger quantities will need to be printed and disseminated.

An intensified "hands-on" approach should be adopted when interacting with landowners and managers.

Advertising followed by exposure to printed materials with concrete examples cited will assist those citizens who are environmentally concerned or otherwise presupposed to this kind of change. Our experience in working with the agricultural community in promoting cost-share, as well as case studies of watershed initiatives nationally, show that the greatest and most efficient change of behavior takes place when mass media messages are accompanied with personal, one-on-one selling. This is certainly more problematic when trying to reach suburban residents rather than farmers. However, through Master Gardeners and other programs administered primarily by the Virginia Cooperative Extension, a network to reach this market segment does exist. These efforts should be intensified to complement the mass media campaign.

The public education component should continue, with outreach to schools as part of science and environmental studies, thereby reaching future stakeholders at all levels.

An evaluation mechanism should be implemented that can be used to attribute actual nutrient reductions to the public education component.

Cost has been one reason a paid mass media campaign has not been implemented previously as a nutrient reduction strategy. The other concern has been how to account for actual reductions. The use of the toll-free number and information gathered by Master Gardeners and VCE would give us a mechanism to do follow up surveys to see what level of behavior change has resulted.

A more expensive, but more comprehensive, method would be to conduct a phone survey of a random sample of residents in targeted areas of the watershed. This survey would determine if the campaign or other factors have led to a change in their use of fertilizers, ground covers, maintenance of their septic system or other factors affecting water quality.

A mass media approach, with fulfillment and increased personal selling are needed if behavior changes are to take place in time to have them counted as reductions under the final interim nutrient cap strategy. This would enhance public motivation, and increase pride of ownership and involvement in the watershed, increasing the stakeholder base of support.

In the long run they also complement efforts by the Chesapeake Bay Program to introduce Bay related messages into the school curricula, provide an outdoor Bay or stream related experience or other intensified public outreach efforts to develop a conservation ethic over time.

(iii) Potential Costs

In purchasing advertising it is important to reach a certain threshold of number of people who are exposed to your message with frequency (number of times they are exposed). For a major market like the Northern Virginia region, a rough cost estimate for an effective campaign is approximately $500,000 to $1,000,000 annually.

c. Urban Nutrient Management

Nutrient pollution from the Potomac's rapidly urbanizing areas and "ultra urban" areas is becoming a greater concern. These concerns were voiced at all thirteen focus group meetings conducted while developing the strategy. Many concerns about the lack of urban nutrient management were also voiced at the Potomac Forum held in August 2000 at George Mason University in Manassas, Virginia.

Current educational programs that specifically address urban nutrient management are limited. Some of these programs, which are administered by the Virginia Department of Conservation and Recreation and Virginia Cooperative Extension, educate the fertilizer industry and suppliers of lawn care services and homeowners on a one-on-one basis. These programs have shown success and need continued funding.

However, there is even a greater need to expand urban nutrient management programs into other areas. These would include writing certified nutrient management plans for golf courses, local, state, and federal government lands, homeowner associations and office parks that would provide land maintenance contract guidelines that incorporate sound nutrient management practices.

Public and private turf landscape areas are increasing in the Shenandoah-Potomac watershed. Public lands are school grounds, athletic fields, playgrounds, parks, municipal government offices, roadsides, federal properties, as well as some hospitals and cemeteries. These entities need nutrient management plans or land maintenance contracts that address nutrient management issues. Private turf and landscape areas typically include office parks, shopping malls, houses of worship, businesses, and common areas of large subdivisions. Many of these areas have extensive turf areas that need to be maintained, often with a high expectation for a lush green appearance. Nutrients applied by private land managers are largely unknown and unregulated. Both public and private land managers would benefit from regular educational opportunities concerning proper fertilizer selection, timing and application. Addressing these areas offers an attractive way to put nutrient management conservation practices on a significant amount of urban acreage effectively and efficiently with a voluntary program.

Golf courses are an increasingly common landscape feature. Management strategies to protect water quality with this land use should be directed at water runoff or groundwater infiltration from intensely managed turf areas like fairways, tees, and greens. Appropriate Nutrient Management strategies need to be developed for golf

courses. Both private and public certified nutrient management specialists should be able to write certified nutrient management plans. Furthermore the current Nutrient Management Training and Certification program is heavily weighted towards knowledge in the agricultural sector. Appropriate changes to the Certification process of private planners to address urban nutrient management are needed. Research and demonstration efforts to increase the number of management tools to more appropriately apply nutrients to golf courses are needed.

Managed lawns are a common feature in urban and suburban areas of the Shenandoah-Potomac watershed. According to the 1998 Virginia Agricultural Statistics, Virginia has some 714,000 acres of home lawns, with more acres expected. Due to the large number of individuals involved in the care of home lawns, a successful nutrient management strategy should proactively address lawn care awareness among the general public. Free educational opportunities for interested homeowners to learn correct and unbiased methods and practices related to lawn fertilizer selection, timing, and application should also be provided. Some work in this area is already being provided with Water Quality Improvement Act grant funds through local Virginia Cooperative Extension offices.

Deicing materials that contain ammonium nitrate and urea are commonly used on public and commercial roads and parking lots. These materials represent a potentially significant nitrogen load to receiving waters during snowstorms. Alternative deicers such as granular and liquid calcium chloride exist, but storage facilities for these materials would need to be developed to allow for bulk purchase and use. Educational programs could be developed to educate contractors on the safe use of deicers. Furthermore, labeling laws could be instituted to prevent deicers sold across the counter to contain nitrogen or phosphorus products.

Biosolids, the product of sewage treatment plants, present many nutrient management opportunities. Pelletizing the biosolids into an acceptable consumer product would remedy negative public perception concerning odor with regular biosolid applications. Pelletized Class A biosolids are not currently regulated, can be sold and shipped as a commercial fertilizer, and generally have fewer public perception problems than the regulated biosolids. Nutrient management practices should be used to help develop marketing opportunities for the biosolids to offset treatment costs to municipalities and ensure safe use at the land application site. Phosphorus based nutrient management and the expanding poultry industry will make pelletized biosolids compete for a finite amount of agricultural land that needs to receive supplemental nutrients. However there appears to be some opportunity for pelletized biosolids to compete with commercial phosphorus fertilizer products, such as diammonium and monoammonium phosphate, that are currently being used.

Improperly disposed pet waste is a potential source of nutrients as well as fecal coliform bacteria. Greater awareness among the general public as well as enforcement of existing regulations is recommended.

d. On-site Wastewater Treatment

There is strong concern across the Shenandoah-Potomac basin for pollution attributable to failing or malfunctioning septic systems. Several streams in the watershed are listed as impaired and are thought to be impacted by wastewater. Communities along these streams expanded or were developed from about the 1930s through 1970s. Malfunctioning on-site wastewater treatment is likely a major source of bacteria and nutrient contamination in the streams. Leaking septic tanks or pipes may also be a source of nutrients transported to waters underground or in streams.

Much of the developed area in the Shenandoah River watershed is underlain by carbonate rock. Fractures and dissolution channels occur frequently in the folded limestone and shale of the valley. There are numerous sinkholes and limestone outcrops. Soil depth may be shallow over shale, and soil depth in areas of limestone outcrops is very irregular. These conditions allow a direct flow-path underground for surface runoff or wastewater discharge. The resulting communication of surface water with water underground plays a major role in the transport of nutrients to streams. During periods of no precipitation, the contaminated water underground provides base-flow (via springs) to streams, and possibly sustains elevated nutrient concentrations in the streams.

Focus group participants identified three conditions on which to concentrate. (1) Maintenance and inspections of the small wastewater treatment systems (discharge less than 0.5 million gpd). (2) Maintenance and long-term needs of on-site wastewater treatment (septic) systems. (3) Malfunctioning septic systems in areas of karst, where there is a greater risk of groundwater contamination via dissolution channels and fractures in carbonate bedrock. Suggested strategies to address these issues were (1) homeowner education programs emphasizing the need for septic system inspection and pump-out. (2) a local sponsor for the State Revolving Loan Fund for on-site system installation, and (3) cost-share for repair or replacement of failing/malfunctioning systems.

A homeowner outreach/education program to increase proper maintenance of septic systems would have strong benefits for nutrient cap maintenance. While septic system pump-out does not reduce release of nutrients, the properly maintained systems last longer and have better pathogen reduction. Pump-outs prevent potential clogging of the drainfield, therefore preventing drainfield failure that would result in potential nutrient runoff.

Other suggestions favored creation of a grant or loan program for the county to manage a program aimed at inspection and maintenance of septic systems/alternative systems, and the creation of ordinances to ensure sufficient land for drainfields and repair areas on newly subdivided parcels. Also suggested was making septic system siting requirements regionally specific, thereby taking into account soil variations throughout Virginia.

Additionally the use of alternative on-site treatment systems for clusters of residences has potential to alleviate problems where several septic systems have failed. Consideration should be given to making grant funds available for installation of a cluster wastewater system infrastructure that offers wastewater services under a management program to a group of 3 to 100 homes per cluster. Local government must have the lead for operating such a system and charging a "sewer" fee to users as is done for large centralized system. One possible objective for use of funds on wastewater projects should be to treat wastewater and adequately disperse the effluent into the environment, rather than for the collection of raw sewage and moving it around in miles of sewer infrastructure.

e. Agriculture

Maintaining the nutrient reductions achieved through the *Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy* will require Virginia to maintain current programs as well as consider and adopt innovative implementation strategies for agricultural BMP implementation. It is necessary to target and promote additional implementation activities that will maintain nutrient reduction goals.

The successes of the Shenandoah and Potomac Tributary Strategy Implementation Project were a direct result of the adequate levels of funding for agricultural BMPs through the Water Quality Improvement Act. Watershed stakeholders have emphasized that funding will be the key to a successful Interim Nutrient Cap Strategy. Cost-sharing and other incentive-based programs have a proven track record of getting conservation on the ground. It is necessary to continue with adequate levels of funding for current nutrient reduction activities such as agricultural nutrient management and BMP cost-sharing, as well as new implementation activities. Without adequate funding to continue on going activities it will be difficult to maintain current reduction levels.

A significant portion of the nonpoint nutrient reduction in the original Shenandoah and Potomac Tributary Strategy came from agricultural BMPs implemented through the local soil and water conservation districts. In order to effectively promote and implement these BMPs, local soil and water conservation districts need to have staff resources to provide technical assistance to landowners in the watershed. Nutrient management plans also contributed to a large part of the nutrient reduction goal. Nutrient Management planning as well as many of the agricultural BMPs are the most cost-effective methods of achieving nutrient reductions.

The following Best Management Practices are offered through Virginia's Agricultural Best Management Practices Program. Continued funding and promotion of these practices remains critical to a successful Cap Strategy.

Table 8 Menu of Agricultural Best Management Practices

Best Management Practices	
BMP Treatment	**Units**
Conservation Tillage	acres
Farm Plans	acres
Nutrient Management	acres
Highly Erodible Land Retirement	acres
Grazing Land Protection	acres
Stream Fencing (Livestock from Streams)	ln. ft.
Cover Crops	acres
Grass Filter Strips	acres
Woodland Buffer Area (including CREP)	acres
Animal Waste Control Facilities	systems

Additional nutrient reduction activities exist in the agriculture sector. These include the targeting of the horse industry by promoting grazing land protection practices and manure management practices.

Nutrient management planning has targeted both the poultry industry and the dairy industry. The poultry industry is well established in the Shenandoah portion of the watershed. Current regulations require most poultry operations to develop a phosphorus based nutrient management plan. Any plan written after October 1, 2001 for a poultry grower must be a phosphorus based nutrient management plan. This represents a significant workload for public and private nutrient management planners. To comply with state regulations, these operations will be required to have an updated plan written every 3 –5 years which facilitates the process of establishing a nutrient Cap on poultry litter produced in the basin.

Changes in poultry litter market conditions have resulted in additional poultry litter from outside the watershed being transported into the Shenandoah-Potomac watershed. Additionally the continued encouragement of certain feed additives such as phytase, which reduces phosphorus in poultry manures. In addition many beef producers are using poultry litter from the Shenandoah basin as fertilizer. Appropriate nutrient management practices need to be more widely promoted on these beef cattle farms to ensure that poultry litter is being applied at proper rates and current nutrient reduction gains are not eroded.

The dairy industry, estimated to be about 45,000 cows in the Shenandoah-Potomac basin, is a significant portion of the basin's agricultural base. Although the majority of these farms have current nutrient management plans, there are still a number without a plan. Continued targeting of the dairy industry is necessary in order to plan those remaining farms.

Additional activities outside of traditional government sponsored programs are also necessary to achieve additional reductions. Public grant funds, loans and incentives are needed in order for the private sector to develop and implement projects resulting in new reductions. However, a significant number of basin stakeholders have pointed to the urban and suburban communities for providing additional nutrient reductions.

f. Shoreline Erosion and Protection

The Virginia Department of Conservation and Recreation's Shoreline Erosion Advisory Service (SEAS) staff tracks nutrient and sediment reduction progress in the Lower Potomac River through shoreline protection measures installed based on the Virginia Marine Resources Commission permit data. The data provides information about shoreline protection measures being installed by property owners. The SEAS tracking data for January 1 – December 31, 2000 is expected to be available by June 1, 2001. The types of shoreline structures permitted from January 1, 1990 through December 31, 1999 are:

Structure	Linear Feet (protected)
Riprap	25,595
Bulkhead	13,648
Breakwaters	3,930
Groins	20,654
---	---
Total	63,827

In addition to the SEAS tracking of shoreline protection measures installed, the Bank Erosion Study (1992) found that 8,270 feet of shoreline had been stabilized from 1985 through 1990. The shoreline identified in this report is located in Westmoreland and Northumberland Counties. Therefore, the total length of shoreline protected in the Lower Potomac from 1985 –1999 is:

Data Source	Linear Feet (protected)
SEAS Tracking	63,827
Bank Erosion Study	8,270
---	---
Total	72,097

Nutrient reductions from shoreline erosion control measures can be calculated through December 31, 1999 using the above information. However, to calculate reductions through December 31, 2000, SEAS tracking data was averaged to provide an installation rate of 6,383 feet. Therefore, nutrient reductions from shoreline erosion control through December 31, 2000 are:

Elements	Target	Achieved	Surplus (+)
Shoreline length (feet)	76,000	78,480	2,480
Nitrogen (pounds)	51,680	53,366	1,686
Phosphorous (pounds)	20,520	21,190	670

The nutrient reduction and shoreline protection goals established by the *Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy* have been met. In fact, they were exceeded and future implementation of shoreline protection measures will generate additional surplus reductions. The existing and future surplus reductions may be used to offset gaps in other program areas.

The Lower Potomac River data does not track shoreline protection measures installed on the tributaries of the Potomac and the main stem of the Potomac upstream of King George County. To more accurately track nutrient reductions related to shoreline protection, all shoreline hardening should be tracked and counted. The nutrient reduction factors should be evaluated and revisions adopted if all shoreline is considered in the strategy.

Private residential landowners implementing shoreline erosion control measures account for the nutrient reductions in the Lower Potomac. However, residential development is not the predominant shoreline land use category for the majority of property in the Lower Potomac River. A large portion of the shoreline is agricultural and many landowners do not have the resources available to protect the shoreline. The current incentive for agricultural landowners is a 25 percent tax credit. One program to address agricultural landowners, as well as residential property owners, is a cost-share program for properly designed and constructed shoreline protection measures (structural and non-structural). A 50 percent cost-share program is recommended for the design and implementation of properly designed shoreline erosion control measures. Incentives involving a new cost-share program and the existing tax credit program would complement the Conservation Reserve Enhancement Program (CREP).

B. Implementation Challenges and Solutions

Two significant challenges associated with developing and implementing the Interim Nutrient Cap Strategy for the Shenandoah and Potomac are 1) urban stormwater management and 2) urban BMPs as they relate to new development and previously developed areas. These are discussed in detail below. Other challenges which need to be addressed include: developing guidelines or policies to address significant new sources of nutrient loads from agricultural and urban sources; financing nutrient reduction activities and developing a tracking system. One solution necessary for the successful implementation of a Cap Strategy is a change in lifestyle.

Urban Stormwater Management and Urban BMPs

Challenges

There are two major challenges associated with the potential for urban stormwater management and ultra-urban BMPs to help maintain the Shenandoah-Potomac watershed nutrient cap.

1. The first challenge is the degree to which stormwater management practices can be used to ensure that **new development** is conducted in a manner that approaches a "true" no net increase in nutrient pollution, therefore negating the need to off-set increases elsewhere.

2. The second challenge is the degree to which urban stormwater management and ultra-urban BMPs implemented in **previously developed areas** can be utilized to offset increases elsewhere or contribute to a net decrease in nutrient loads to the Chesapeake Bay.

Solutions

New Development

Two primary solutions must be implemented in order to maintain the nutrient cap through stormwater management and ultra urban BMPs.

1. All Potomac watershed localities, and not those just in Tidewater, must adopt jurisdiction wide DCR stormwater management *technology-based* water quality criteria.

2. Even with universal *technology-based* water quality criteria in place, additional innovative measures would be needed to approach a true no net-increase in nutrient pollution as a result of new development. These innovative measures include *low impact development* and *better site design techniques* (see Appendix E). Implementation of these practices will reduce the pollutant load entering a stormwater BMP thereby enhancing the long-term effectiveness.

In either case, additional burdens would be placed on local governments to administer and enforce these strategies while some additional costs would be borne on developers to actually implement the required BMPs.

Previously Developed Areas

There are four primary actions that need to be addressed with regard to implementing BMPs to control nutrient pollution from existing development in order to offset gains elsewhere.

1. Establish a secure funding source or mechanism. Because agricultural BMPs are far more cost-effective to implement based on pounds of nutrients per dollar spent, urban BMP measures have not been a target of funding mechanisms such as the Water Quality Improvement Fund until this year.

2. Hand in hand with a funding mechanism to implement retrofits in previously developed areas is the funding for on going maintenance. Since retrofitting typically does not involve assigning responsibility to a single developer or business, the locality would be responsible for long-range upkeep. While many localities may be willing to maintain a few BMPs, few would be willing to take on a large number without a dedicated funding source. Localities are afforded the option of adopting a local Stormwater Utility Ordinance (SUO) for such purposes. Prince William County as well as a number of Hampton Roads localities have adopted this approach. However, without such a funding mechanism, it may make it impossible to implement widespread BMP retrofits. Without a uniform funding system, development may find itself concentrated in areas without SUO requirements, where the infrastructure is least able to handle the additional development.

3. Due to limited space, innovative technologies such as street sweeping, green rooftops, and in-line BMPs must be implemented to help reduce the existing developed condition load.

4. While innovative technologies such as green rooftops, street sweeping, and in-line BMPs can help overcome the challenges associated with urban BMP retrofit, the development of accepted nutrient standards for these practices must be developed.

Change in Lifestyle

In order for local communities to successfully meet their respective goals in the Cap Strategy, a revolutionary change in lifestyle will need to occur. Local communities will be called upon to revise existing codes and ordinances, create new structures and approaches, and modify existing behaviors. Local communities will need to actively encourage environmentally sensitive development and redevelopment, minimize and mitigate for existing development, and rehabilitate areas currently impacted. The following recommendations are promising changes to our existing lifestyle that will help us reach our Cap Strategy goal.

- The use of Low Impact Development, Better Site Design Principles, Clustering, Blue/Green Technologies, Project Phasing, Growth Channeling and Growing Greener Design Principles will need to be expanded throughout the watershed.

- Fully consistent local Erosion and Sediment Control Programs, Stormwater Control Programs and Chesapeake Bay Preservation Act Programs will need to be the standard for all communities.

- New materials and technologies such as erosion control flocculants, porous pavement alternatives, rooftop bioretention and composted BMP filter material will have to become commonplace.

- Day lighting pipe systems, stream channel stabilization thru bioengineering, riparian rehabilitation and buffer restoration for our degraded and impaired local stream sections will need to be dramatically increased.

- Increased BMP retrofitting, expanded urban turf management programs, imprinting storm drains with a pollution prevention message as per new V.D.O.T. specifications and the full utilization of highly efficient street sweeping equipment will benefit nutrient reduction in already developed areas.

- The creation of an urban nutrient trading system will provide a monetary incentive to those wishing to go further than existing practices and minimum regulatory requirements.

- Encourage the application of computer technology allowing for an increase in telecommuting and E-commerce thus reducing our dependence on automobiles, roads and associated pollution.

- Encourage the use of carpooling, alternative transportation, and mass transit to reduce pollution associated with automobiles and roads

VI. Objectives and Options for Final Nutrient Cap Strategy

This Section provides a brief overview of some of the major objectives to be realized in order for Virginia and her citizens to develop and implement an effective final nutrient cap strategy. These objectives reflect the challenges identified in Sections IV and V as well as logistical issues associated with operating a nutrient cap program. The unifying goal of the 6 identified objectives is to determine the lines of responsibility within which effective tracking and equitable implementation can occur while achieving no net increase in nutrient loads. Adherence to this unifying goal will be the primary consideration when evaluating all decisions related to each particular objective. Addressing factors of equity and cost-effectiveness is imperative; however, the incorporation of local perspectives and citizen input is of the utmost importance to the fulfillment of these objectives.

Six Major Objectives Related to Developing and Implementing a Nutrient Cap Strategy

1. Initiate a process, using a grassroots approach, to develop and assign lines of responsibility within the Shenandoah-Potomac basin (either by locality, region or groups of sources) for measuring and accounting to achieve no net increase in nutrient loads.

   The original *Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy* did not place specific responsibility on individual localities, major sources or types of sources (i.e., point sources and nonpoint sources) for achieving the 40 percent nutrient reduction goal. The nutrient reductions have been achieved through a cooperative approach among regions, localities, farmers, point sources, etc. The ten soil and water conservation districts in the watershed voluntarily agreed to reduction allocations to assist with implementation.

   Efforts to meet the 40 percent goal have exhausted many of the easiest and most cost-effective nutrient reduction practices in the Shenandoah-Potomac basin. As pressures increase to maintain the target nutrient load, it will be important to establish practical and equitable lines of responsibility to offset load increases that result from growth, development or other nutrient sources.

   In Virginia, land use issues have traditionally been handled at the local government level. While maintaining the nutrient cap is not the responsibility of local governments, it may be reasonable for local jurisdictions to represent the primary boundaries for measuring and achieving no net increase in nutrient loads. Such a local approach would likely be augmented with certain agreements and regional policies among local governments in the Shenandoah Valley, Northern Virginia and Northern Neck regions. These larger-scale approaches and policies could easily be dovetailed with the general framework of local boundaries and responsibilities.

2. Once these boundaries are established, develop "baseline" nutrient load caps to be allocated to these entities.

The task of determining nutrient load caps for individual localities, regions or groups of sources in the Shenandoah-Potomac basin reflects fundamental issues of equity and fairness. The caps must be established in a way that does not punish the localities and regions in the watershed that have not yet experienced reasonable rates of growth and economic development. The caps must also reflect the robust nutrient reduction efforts that have already taken place through implementation of the 1996 strategy.

The current load in less-developed regions in the Shenandoah-Potomac basin results from relatively high acreage of agricultural land. Given that pollution impacts from agricultural land use typically are less than those from developed urban areas, we need to insure that we maintain a certain amount of agricultural land. However, if agricultural land is developed using effective zoning and stormwater management programs, then reductions in nonpoint source nutrient loads could be achieved, allowing part of the increased point source loads that result from population growth to be offset.

For the Shenandoah Valley, agreement was reached in the 1996 strategy that nutrient reductions from Valley point sources (through installation of biological nutrient removal) that surpass the 40 percent goal for the region would be credited toward maintaining the nutrient cap in the Valley, rather than being used to help more developed regions reach their 40 percent nutrient goal. This agreement helps to promote equity for differing levels of growth that have occurred in the basin.

One possible approach to setting load caps would be to maintain the nutrient loads for each of the regions at the levels observed subsequent to full achievement of the 40 percent nutrient reduction goal. In each of these regions, local governments could choose to continue to work cooperatively to maintain the allocation cap or decide to accept and maintain their local portion of the capped load.

The Chesapeake Bay Watershed computer model, which estimates nutrient loads on a relatively large scale, will be used to determine when the 40 percent reduction goal is achieved. At that time, a tracking program that can account for smaller scale increases and decreases in nutrient loads will be necessary (refer to objective #6).

3. Design and achieve equitable programs and/or scenarios for minimizing load increases (i.e., local government programs).

A major component of the nutrient cap strategy will be programs, operated mostly at the local level, that help reduce the nutrient load impacts of growth, development and land conversion. These programs include various zoning requirements, stormwater management programs, land conversion programs and

Chesapeake Bay Preservation Area programs in Tidewater localities. They also include ways to ensure that all new point sources include biological nutrient removal technology in new facility design and construction.

An important challenge within the nutrient cap strategy will be identifying ways to promote and achieve widespread application of these programs through a cooperative approach that does not create competitive advantages or disadvantages among localities seeking economic growth. The more effectively these programs are developed and implemented across the basin, the less it will be necessary to locate and implement practices to offset load increases.

State and local governments should pursue equitable programs across the Shenandoah-Potomac basin to ensure that new land conversion and development minimizes resultant nutrient load increases. These programs should focus on managing and processing runoff from urban and suburban areas.

4. Secure sufficient funding to accomplish offsets for those increases in loads that can not be further reduced.

Implementing the 1996 strategy and meeting the 40 percent nutrient reduction goal was supported through cost-share funding under the Virginia Water Quality Improvement Act of 1997. Unlike the specific task of meeting the reduction goal, maintaining a nutrient cap is a long-term goal that will be finished only when the Shenandoah-Potomac basin is no longer experiencing population growth or new land conversion. Therefore, an important element of a successful nutrient cap strategy will include ways to ensure that nutrient load increases are offset, even during times of little or no funding.

Once lines of responsibility for achieving no net increases in nutrient loads are established (i.e., nutrient load caps, refer to objective #1), nutrient "trades" can occur where payments are made to other sources for reductions that will offset load increases experienced by a locality, point source or other nutrient source.

Funding availability for cost sharing of nutrient reduction practices reflects economic cycles. To minimize the impacts of economic vagaries on maintaining the nutrient cap, it is important for all parties involved in this program to provide elected officials with accurate and up-to-date information on the values, needs and water quality benefits of nutrient reductions in the Shenandoah-Potomac basin.

To date, no demand or need for a nutrient trading program has been demonstrated in the Shenandoah-Potomac basin. However, effective implementation of a nutrient cap program will require a nutrient trading program that has the assurances and support of the Commonwealth of Virginia and its agencies. Such a program should be developed prior to demonstration of need in order to take advantage of the most cost-effective nutrient reduction practices and solutions. This program should be based, to the maximum extent practical, on the nutrient

trading fundamental principles and guidelines that have been developed by Virginia and her partners in the Chesapeake Bay Program (see Attachment C).

5. Secure sufficient authority to accomplish offsets for those increases in loads that cannot be further reduced.

The effective implementation of a trading and offset program will not only require formalized nutrient load caps, it will also require a program that can facilitate and recognize transfers of funds and nutrient credits among sources and/or localities. Depending on program design, the recognition of an offset could be limited to an individual locality, a watershed sub-region or region, the state or the entire bay drainage basin. Whether such authority is drawn from a local ordinance, an inter-local agreement, a state permit or some other legal contract; the enforcement mechanism chosen will depend largely upon the desired scope of the offset program.

The broadest ranging nutrient trading program (one that would allow trades between different types of sources throughout the bay watershed) may offer the most flexibility to meet water quality goals while simultaneously coping with increased nutrient loading pressures. However, developing sufficient authority to adequately enforce such a broad ranging program would likely present the most significant challenges.

6. Develop a program to track increases and decreases in loads.

The means by which increases and decreases in nutrient loads are tracked across the Shenandoah-Potomac basin will partly depend on how lines of responsibility are drawn among localities, regions or groups of sources for maintaining a no net increase in nutrient loads (refer to objective #1). However, it is likely that this task will be undertaken cooperatively among local governments, regional planning district commissions and state Natural Resource agencies.

The design of a template for the development and operation of nutrient tracking programs must be a top priority. This template should address ways to track land conversions as well as local and state programs that minimize the nutrient impacts of these conversions.

Continued efforts should be made by Virginia state agencies to integrate this data into the database used for the Chesapeake Bay Watershed computer model. A discussion of different options for the development of a tracking system is included in Section VII of this document.

VII Schedule/Recommendations

Discussions among stakeholders have yielded two general options on how tracking and accounting could be achieved. They are listed and described below.

1. Assignment of Loads

One option is to use the Bay Watershed model to determine when and where we have met the nutrient goal and then to cap the loading geographically, politically, by source or by watershed. The advantage of this approach is that the expectations and goals are clear. The disadvantage is that none of the above groupings should be assumed to be separate and coordinated entities. Further, the assignment of maximum loading based on the Bay Model would be controversial since there is much disagreement in the quality of the input data.

2. Local Participation/Ownership

At the focus group meetings it was acknowledged that the success of the cooperative voluntary approach was dependent on involvement at the local level. The localities are in the best position to facilitate success since they are often owners of the larger sewage systems; responsible for nonpoint sources through programs like erosion and sediment control; and serve as a representative for citizens and commercial operations. For these reasons it was proposed that the localities take a coordinating role to encourage citizens and commercial operations to participate and then account for loading within their jurisdiction. One benefit for the locality is that it would be speaking for itself and providing more accurate information to be used in the Bay Model.

In taking a coordinating role the localities would:

- Designate a nutrient coordinator to monitor/track/report loading within the locality
- Monitor NPS runoff and record point sources loading
- Gather and report all related data such as water quality, land-use, BMP implementation
- Perform annual assessments
- Report annually to local planning district commissions

This approach would give the localities the chance to demonstrate individually and collectively to the state that nutrient loads are being controlled, thereby postponing the difficult and subjective task of making allocations. The PDCs are key links to the localities and, as such, could serve as coordinators to make certain that a regional approach is maintained.

The determination and design of a tracking and accounting program for nutrients across the watershed is integrally related to the way in which loads are allocated among

local governments, regions or groups of sources in the basin. These two decisions must be made in concert in order to establish an effective nutrient cap program.

The following schedule has been drafted to guide the development of the tracking program and the establishment of lines of responsibility.

Table 9 Proposed Schedule for Tracking and Accounting System Development

Objective	Task	2001 Time Frame
Establish line of responsibility (using grassroots approach)	Establish workgroups to investigate and evaluate 3 options for assigning, accounting and tracking allocations (by locality, by region, by groups of sources)	May
	Workgroups meet and develop proposals	June – Aug
	Workgroups submit report to Cap Advisory Team	Sept 1
	Report distributed to Potomac Roundtable and Shenandoah equivalent for comment	Sept
Design template for the development and operation of nutrient tracking	Establish a workgroup to coordinate and develop recommendations for a tracking program	May
	Agree on process for developing tracking program	June
	Survey sent to all localities in watershed to establish baseline or current tracking levels/capabilities	July
	Survey data compiled – workgroup meets to discuss	August
	Findings of surveys and options distributed to Stakeholders for comment (Potomac Roundtable and Shenandoah)	Sept

Remaining steps through 2002 are to be scheduled after completion of public comment period.

APPENDIX A

SYNOPSIS OF
SHENANDOAH AND POTOMAC
LOCAL FOCUS GROUP MEETINGS

Guidance from Shenandoah and Potomac Stakeholders

Early in the interim cap strategy process, it was determined that for the strategy to be effective, it would need to be built from the ground up and include feedback from stakeholders within Shenandoah-Potomac basin. The cap strategy steering committee set up local government meetings in the Shenandoah Valley, Northern Virginia and the Northern Neck. They then set up ten focus groups throughout the Shenandoah-Potomac watershed with state, regional and local planning staff participants. In both sets of meetings a set of ten questions were used to facilitate discussion.

A. Ten Questions to Facilitate Cap Strategy Discussion:

1. How successful was the original Shenandoah and Potomac strategy in your jurisdiction? What elements of the strategy failed or succeeded? How can we make improvements?

2. What practices or activities are already going on in your jurisdiction that we have not yet accounted for? How are you tracking these activities and can we quantify them?

3. What local programs such as "low impact development or cluster development", or what BMPs eligible for cost-share, do you currently implement that reduce or minimize nonpoint source nutrient pollution?

4. Do you have any projections for future growth (including point source flow increases) and development in your jurisdiction? What types of business and/or industrial expansion do you anticipate?

5. What types of additional management practices or programs, or agricultural BMPs, would be beneficial for maintaining the nutrient cap in your jurisdiction? Which are the most cost-effective?

6. What actions are you willing to undertake or endorse to maintain the cap?

7. Which of these are doable now? Which would require additional authority or statute?

8. Are there any other impediments to implementing these practices or programs?

9. How would you like to see the process handled for accounting, tracking and measuring nutrient increases and reductions in your jurisdiction? Do you think it is appropriate to work regionally or cooperatively among types of sources?

10. Would you make use of a trading and offsets program? How would you like to see us institute and operate a nutrient trading program?

The answers to these questions, as well as additional information provided by participants, were compiled into two summaries (one for Shenandoah basin and one for Potomac basin) which have guided the development of this Interim Nutrient Cap Strategy. These summaries are included in the following section.

B. Synopsis of Major Messages from Potomac Basin Local Focus Groups

Funding was the key to success - Cost-share funding through Water Quality Improvement Act was the key to the success that has been achieved under the original strategy. Local officials and stakeholders expressed that funding would continue to be the key to strategy success, regardless of the approach taken through the Interim Nutrient Cap Strategy.

It was recommended that consideration should be given to instituting a broader range of incentive programs and cost-share eligibility. In particular, cost-share funds need to be targeted toward urban nonpoint source pollution control projects in order to achieve the necessary level of nutrient reductions.

Local Water Quality Issues Remain Critical – As in the original strategy, it is imperative that local water quality issues are recognized as being as important as the more larger scale benefits of nutrient reductions. Interim cap strategy policies and funding decisions should reflect the synergistic effects of local/regional water quality improvements. Local issues particularly include stream protection and stabilization.

Benefits of Regional Approach – Although most local governments are cautious about regional efforts, most recognize that the Potomac region will not be able to optimize economic and environmental benefits to their citizens without additional regional cooperation in the areas or transportation, development planning and conservation.

Challenge of Growth/Equity – Growth in many areas of the Potomac watershed will be an incredible challenge in the years to come, environmentally and otherwise. As an Interim Nutrient Cap Strategy is developed, it should recognize this challenge and the equity associated with a region's stage of development. Areas that have not yet developed do not want to be the watershed "open space area" for other areas that have already developed. In this vein, urban areas need to be rewarded for encouraging infill and redevelopment that may minimize sprawl.

Far-field and Innovative Solutions – The level of this challenge indicates the need to look in all available places for nutrient reductions and innovative solutions. This includes reductions associated with Clean Air Act implementation, inclusion of non-signatory states into the Bay Program and new technologies associated with everything from wastewater treatment to transportation.

Enhanced Local Authority – The Commonwealth comes to us with one hand, asking for increased levels of nutrient reductions, yet with the other hand they refuse to give us the authority (statutory) to manage our land and economy in a way that optimizes economy and quality of life for our citizens. The General Assembly must develop trust of local officials' ability to manage growth and development within their jurisdiction in a way that reflects the wishes of their citizens.

Better Information on Benefits – For full implementation of a nutrient reduction program, local officials (including soil and water conservation districts) need better information on the environmental benefits of nutrient reductions and the programs that are under consideration. On a smaller scale, better information is also needed on the relative (and absolute) efficiencies of different BMPs. This information should be continually updated as it becomes available.

Stormwater Management is a Key Issue – The single most important problem and opportunity for nutrient reductions and water quality improvement is the effective management of stormwater and the design/construction of methods and facilities that effectively process or retain nutrients. Essential to this are programs for operation and maintenance that ensure these systems continue to function and do not create safety hazards or other problems.

Septic Tanks are also Critical – Old septic tanks and the proliferation of new tanks are a major problem throughout the watershed; and there does not seem to be any great, affordable answers to these problems. Need better information on the nutrient problems associated with septic tanks and how these problems are best managed. Need cost-share funding for appropriate solutions and ways to evaluate benefits of sewer line extensions as an alternative.

Options for Ultra-Urban Environment – Given the impacts of highly urbanized areas, need more consideration and possible funding for innovative solutions to water management in these areas. Solutions may include "green rooftops" and other means to recycle and infiltrate stormwater and associated nutrient load.

Benefits of Low-Impact Development – Low-impact solutions that do not create the need for off-site facilities should be fostered, approved and funded wherever possible. The state should lead efforts for research and practical application of these design principles. Nutrient reduction credits should determined for all nonstructural BMPs and practices.

Other Available Planning Options – There are numerous opportunities from a local planning perspective to effectively reduce nutrient loads (cluster developments, etc.) from newly developed areas. These should be evaluated for their ability to minimize impacts of new development and, in some cases, for whether adequate statutory authority exists for application of these planning tools.

Accuracy of Current Chesapeake Bay Computer Model – General concern was expressed over the accuracy and usability of the Chesapeake Bay Watershed Model. Local officials believe that any tracking system developed at a regional/local scale will likely be much more accurate than the Watershed Model and that these tracking systems should provide the basis for accounting under the cap strategy. In addition, results from water quality monitoring should continually be fed back into the modeling program (and information made available) to ensure real-world applicability of clean-up effort.

Tracking System Should Begin with Effective State Model – As localities consider options for tracking nutrient load increases and decreases, the state should provide information and options on how such a system could be effectively developed and implemented. Such a model should also include efficiencies for various land-use conversions and other necessary calculations.

Education and Public Outreach – This effort needs to be spearheaded with a basin-wide education/outreach campaign that generates local citizen and business support for the initiatives that will be considered and undertaken by state and local governments. With an effective media campaign, local governments, farmers and the development community will more easily buy into being a partner in the nutrient reduction effort.

Expanded Nutrient Management Planning – The principles and application of nutrient management planning need to be significantly expanded in rural areas (such as cycling of poultry litter) and urban areas (residential fertilizer application). These initiatives need to be supported and funded by the state if we are to realize long-term benefits of nutrient reduction in the Potomac Watershed.

Monitoring – Ensure that continued monitoring by the state agencies occurs so that we continue to have feedback on what works most effectively.

Trading – Trading programs could provide valuable opportunities but could potentially create problems of their own. Local officials should continue to be involved as options are considered for trading program development.

C. Synopsis of Major Messages from Shenandoah Basin Local Focus Groups

On-site Wastewater Treatment - Participants identified three areas on which to focus: (1) The need for maintenance and inspections of the small wastewater treatment systems (discharge less than 0.5 million gpd). (2) Maintenance and long term needs of on-site wastewater treatment (septic) systems. (3) Karst areas where malfunctioning septic systems pose a risk to groundwater contamination via discharge into dissolution channels and fractures in carbonate bedrock.

Commonly identified needs were: (1) homeowner education emphasizing the need for septic system maintenance and pump-out, (2) a local sponsor for the State Revolving Loan Fund for on-site systems, (3) cost-share for repair or replacement of failing or malfunctioning systems. Other suggestions favored creation of a grant or loan program for the county to manage a program aimed at inspection and maintenance of septic systems/alternative systems, and the creation of ordinances to ensure sufficient land for drainfields and repair areas on newly subdivided parcels. Concerning discussion of replacing septic systems with sewers: (1) public owned treatment works (POTWs) are maintained and monitored better than on-site treatment systems, but the POTWs need to plan and possibly retrofit to handle septage, and (2) no data is available on septic system

loading to compare whether effective, cost-efficient nutrient reduction would be achieved.

Infiltration/Inflow - New Market POTW is at capacity and has funding problems with sewer expansion. The town has infiltration/inflow (I&I) problems and is upgrading the plant. Berryville officials cited I&I as problematic. Front Royal expressed concern that they applied for funds to remediate I&I and were turned down. Two notable consequences are: (1) an initial hydraulic slug which races through the plant conveying a nutrient load that impacts the receiving stream, and (2) the wastewater treatment plant takes time to recover from storm loads resulting in more nutrients than normal being discharged. Edinburg officials cited difficulty in raising local matching funds to upgrade their POTW. All municipal officials cited difficulties in obtaining adequate funding.

Funding Assistance - Generally applicable to all areas of the economy is the continued need for WQIF funds for wastewater treatment and for purchase of riparian easements. Emphasis on outreach and citizen education may require a new source of funding accessible by non-profit organizations.

- *Private Sector* - The cap strategy should emphasize the use of public grant funds, loans or incentives (e.g. tax credit) to encourage private industry to undertake projects resulting in nutrient reduction in wastewater effluent. There is a need to consider cost effectiveness of the industrial upgrades. For on-site wastewater treatment, it is desirable to have a cost-share program to replace/repair failing or malfunctioning systems, and there is need for the State Revolving Loan Fund to be available.

- *For Public Organizations* - Funding for small POTWs is needed. Participants recommended that the state commit to a major long-term program to fund system upgrade and repair for smaller POTWs. Problems cited by officials from small communities include difficulty raising local matching funds, inequality of current program for small communities to compete for funds, and funding shortage. Soil and water conservation districts (SWCDs) have staff shortages and therefore cannot monitor status of best management practices (BMPs) such as destruction of fences by flooding, appropriate use of manure storage and compliance with nutrient management plans (NMPs). More local budget assistance to SWCDs may help.

Urban-Suburban Nutrient Management - Homeowners should be targeted for nutrient reductions. Focus outreach efforts on lawn care and combine with promotion of proper septic system maintenance. Manpower (funding) is needed for an effective program. Evaluation of consumer fertilizer use is needed: traditional practices and marketing encourage over-fertilization. Nutrient management plans for golf courses are recommended.

Stormwater Management - There is potential to reduce urban-suburban runoff problems by including buffers in subdivision design or creating greenways as

conservation easements in urban settings. Water quality information needs to be disseminated for the public to get a better appreciation for conditions, but first the data must be collected and analyzed. Local governments do not aggressively pursue stormwater control efforts. The governing agencies need to be educated about stormwater contribution to nutrient loading and innovative controls for nutrient pollution associated with stormwater. One stormwater BMP has been installed in Augusta County Industrial Park and three more are planned.

Riparian Easements - Restoration of riparian areas is critical for the success of the tributary strategy. Inclusion of buffers in subdivision design or creating greenways as conservation easements in urban settings will contribute to reduction of nutrients in runoff entering streams. There is potential for Staunton to adopt an ordinance that reduces taxes on properties having voluntary riparian easements thereby broadening implementation of riparian buffers. Riparian property owners throughout the watershed should be canvassed to determine their participation or interest in easements to protect the watershed. Landowners willing to participate in a conservation easement program may need assistance or guidance through the process. This will require manpower. The Valley Conservation Council now has partnership agreements with all SWCDs.

Public Awareness - Public education is important to the success of the tributary strategy. There is a general lack of public awareness concerning nonpoint pollution source issues. Mobility of human population has resulted in a disconnect with the land and a lack of concern or appreciation for natural resource. There is a need to address a disconnect between government and volunteer monitoring. There is a need for more and better coverage of water quality issues by the mainstream media. Newsletters and web-sites are currently being used by various organizations to promote pollution prevention and implementation of BMPs. The use of testimonials by 'consumers' of BMP programs would be effective in increasing public awareness and acceptance of the programs. A Virginia Department of Forestry official noted that the department is better able to track logging operations because of mandatory notification regulations and penalties for not notifying. Consequently, more BMPs and better tracking have been developed.

Technical Solutions - Shenandoah Valley Pure Water 2000 Forum is planning to develop a Shenandoah River watershed GIS. Water quality data will be related to spatial data depicting geology, soils and land uses. It is desirable to include a database for implemented BMPs.

Water Quality Monitoring - There is a need for the use of citizens water quality monitoring data. In general, a need was expressed for more monitoring to accurately reflect actual water quality as opposed to computer simulation. Monitoring should be applied to gauge the effectiveness of BMPs.

Point Source Nutrient Reduction Measures - Several current nutrient reduction projects were noted as new or innovative, such as: Merck's nutrient reduction program, Augusta County's planned expansion of several WWTPs, and the poultry industry's phytase project.

Nutrient Reduction Accounting for Point & Nonpoint Sources - Voluntary activities need to be accounted for, such as Agriculture BMPs. There is a need for reporting to localities by the state on nutrient reduction progress.

Water Quality Goals Need to be Established - It is likely that 40 percent goal will be increased. Nutrient standards for surface water will be established within three years. TMDLs will drive water quality improvement efforts. Inequities between requirements for large and small wastewater treatment plants should be corrected.

Agriculture BMPs/Nutrient Management - It was noted that grazing land protection practices and nutrient management planning are very cost effective in reducing nutrients. A need was expressed for additional funding for alternative watering facilities for cattle. Nutrients need to be transported out of the Shenandoah Valley. The poultry industry is requiring nutrient management plans of all growers. Adequate cost-share funding for agricultural BMPs was shown to be effective in getting BMPs installed. The CREP program needs to be marketed.

Legislation/Ordinances - Legislation is needed to address inequity of funding available for industrial and municipal POTW upgrades, and to clearly establish Virginia Department of Health as the regulatory authority for all wastewater discharges from alternative on-site wastewater treatment systems including multi-residential cluster systems. County ordinances assuring adequate land area for septic system drainfields (and repair area) were recommended. Staunton may consider a tax credit incentive for implementation of riparian protection on private property.

Growth - In Shenandoah County the greatest percentage of growth in the last ten years has been located outside of utility service areas. Rockingham County issues 600-700 building permits per year, with only 50 percent on public utilities. Subdivisions are encroaching on agricultural areas. Citizens do not seem aware or concerned about impacts of growth in rural areas. Recreational use of the Shenandoah River is increasing, requiring the need for sanitation facilities along the river.

Nutrient Trading - A need exists for a model on how to cooperate regionally and locally on nutrient reduction. Skepticism was expressed as to inequities in nutrient trading. There would be reluctance on the part of Shenandoah Valley localities to trade with Northern Virginia communities.

Interim Cap Strategy
Summary of Public Meetings

Regional kick-off meetings (for elected officials)

Northern Virginia	June 22, 2000
Shenandoah Valley	June 27, 2000
Northern Neck/Stafford/King George	June 29, 2000

Table 10 Focus Group Meetings (13 were held from July through November 2000)

Location	Jurisdictions invited*	Date Conducted
Prince William	Prince William County City of Manassas City of Manassas Park Town of Dumfries	July 17th
Loudoun	Loudoun County Town of Leesburg	July 18th
Fauquier	Fauquier County Town of Warrenton	July 20th
Fairfax	Fairfax County City of Fairfax Town of Herndon Town of Vienna	August 2nd
Northern Neck (Warsaw)	Westmoreland County North Umberland County Town of Colonial Beach Town of Montrose	August 3rd
Arlington	Arlington County City of Alexandria City of Falls Church	August 9th
Verona	Augusta County Highland County Rockingham County	August 15th
New Market	Shenandoah County Page County	August 16th
Front Royal	Frederick County Clark County Warren County	August 17th
Chantilly	Non-government Stakeholders in Northern Virginia	October 5th 10:00am – 12noon
Chantilly	Non-government Stakeholders in Northern Virginia	October 5th 6:30pm – 8:30pm
Northern Neck	Non-government Stakeholder Meeting	October 13th
Stafford	Stafford County King George County	November 27th

* This list is not all-inclusive. The following participants were invited to meetings: local government staff, Soil and Water Conservation District Directors and staff, water utilities, state agency staff, NRCS staff and non-government stakeholders. Local government staff participants included but were not limited to public works, erosion and sediment control, storm water, health, planning, and transportation. Non-government stakeholders included community watershed organizations, environmental groups, agriculture, agri-business, development industry, recreational and commercial boating and fishing, business and industry groups.

APPENDIX B

POINT SOURCE IMPLEMENTATION MECHANISMS AND DISCUSSION

Biological Nutrient Removal

BNR is a treatment process that reduces nitrogen and phosphorus from wastewater treatment plant discharges. This process has been shown to be adaptable to several existing sewage treatment plants. As an extension of the activated sludge treatment process, BNR involves the creation of anoxic and anaerobic zones along the treatment train to allow denitrification of the waste-stream (released to the atmosphere as nitrogen gas) and transference of phosphorus to the waste sludge. Plants that already incorporate the nitrification process (converting the ammonia form of nitrogen to the nitrate form of nitrogen) are especially attractive as potential BNR retrofit projects.

BNR treatment systems can reduce total nitrogen concentrations in the effluent from an average between 18 and 19 mg/L to 8.0 mg/L or less. Similarly, these treatment systems can reduce phosphorus concentrations in the treated effluent from 2.5 mg/L to 1.5 mg/L. The advantages of BNR usage at a wastewater treatment facility extend beyond the benefits enjoyed by the receiving stream. Cost savings may be realized in the form of reduced treatment chemical addition and energy use expenditures. By eliminating troubles associated with filamentous forms of bacteria, the use of BNR typically improves sludge settling characteristics and clarifier performance. These advantages come with a price, however. Even the least expensive retrofits for BNR usually require capital expenditures for baffles, mixers and pumps. The addition of BNR increases the complexity of the treatment process, augments sludge generation, and, unless additional hydraulic capacity is provided, the effective treatment capacity of the plant may be reduced.

Discharged vs. Delivered Loads

An important distinction is the difference between discharged loads and delivered loads. For our purposes, a discharge load refers to the total pounds of either nitrogen or phosphorus that is discharged over the course of a year from an individual point source. The delivered load is the total pounds of either the nitrogen or phosphorus during that year that makes its way from the individual point source to the fall line of the tributary (a line delineating the boundary between fresh and tidally influenced water). “In-stream processing” refers to the natural ability of a water body to assimilate and remove nutrients as those nutrients pass through it (much like a treatment plant does). Even the reduced discharged load from a BNR facility can be reduced even further due to in-stream processing.

“Delivery ratios” (mathematically described as the “load delivered” divided by the “load discharged”) are particularly useful expressions when discussing in-stream processes as they relate to an individual point source. For example, a low nitrogen delivery ratio for an individual point source indicates that the stream removes significant amounts of nitrogen. While point sources discharging downstream of the fall line have delivery ratios equal to 1 (meaning all the discharged nutrients are delivered), point sources discharging at great distances up-stream of the fall line may have much lower delivery ratios. A relationship may exist between a point source’s delivery ratio and its

distance upstream of the fall line. However, given that in-stream processing results from a hodgepodge of dynamic interrelated biological systems, the characterization of any such relationship holds little value without the use of extremely sophisticated modeling techniques.

Challenge and Incentive Grants

The existence of BNR technology at a wastewater treatment plant does not guarantee the optimal use of the technology at each different treatment plant. In order to be effective, BNR requires very tight operator control, an especially daunting task when confronted with variable flow rates, temperatures and organic concentrations. While a dollar figure can be relatively easily assigned to plant equipment changes and process modifications, a price tag for the training, dedication and expertise needed of BNR plant operators is much more difficult to assess.

Challenge and Incentive Grants may be designed to recognize the value of operator expertise by rewarding those facilities that have demonstrated exceptional nutrient removal efficiency. Challenge grants could be designed to reward the treatment plants that demonstrated the best improvement in nutrient removal efficiency. Incentive grants could be designed to reward each BNR plant that met a set target for enhanced nutrient loading reductions. BNR workshops would be held in conjunction with these grants to facilitate the sharing of operator expertise and to strengthen the effectiveness of BNR throughout the river basin.

APPENDIX C

EXECUTIVE SUMMARY
OF THE DRAFT DOCUMENT,
"CHESAPEAKE BAY PROGRAM
NUTRIENT TRADING
FUNDAMENTAL PRINCIPLES
AND GUIDELINES"
(NOVEMBER 29, 2000)

APPENDIX D

GLOSSARY OF
BEST MANAGEMENT PRACTICES
FOR NONPOINT SOURCES

The following glossary presents brief definitions of some of the more common stormwater BMPs. The reader is encouraged to further research these BMPs for additional information such as appropriateness for a particular development, specific target pollutant removal capabilities, planning considerations, design criteria, long term maintenance requirements, etc.

Extended Detention Basins

An extended detention basin temporarily impounds runoff and discharges it through a hydraulic outlet structure over a specified period of time to a downstream conveyance system for the purpose of water quality enhancement or stream channel erosion control. While a certain amount of outflow may also occur via infiltration through the surrounding soil, such amounts are negligible when compared to the outlet structure discharge rates and, therefore, are not considered in the facility's design. Since an extended detention basin impounds runoff only temporarily, it is normally dry during non-rainfall periods.

"Enhanced extended detention" refers to an extended detention basin which has been designed to include a shallow marsh in the lower stage of the basin in order to increase the pollutant removal capability and decrease the chance of re-suspension of previously deposited pollutants.

Retention Basins

A retention basin is a stormwater facility that includes a permanent impoundment, or pool of water, and, therefore, is normally wet, even during non-rainfall periods. Inflows from stormwater runoff may be temporarily stored above this permanent pool for downstream flood control and channel erosion control. A retention basin is considered one of the most reliable and versatile BMPs available.

Constructed Stormwater Wetlands

A constructed stormwater wetland is an area intentionally designed and created to emulate the water quality improvement function of wetlands for the primary purpose of removing pollutants from stormwater. Like a retention basin, a constructed wetland will contain a permanent pool of water with various water depth zones to encourage specific emergent and upland vegetation.

Infiltration Facilities

An Infiltration facility temporarily impounds runoff and discharges it via infiltration through the surrounding natural (in-situ) soil profile. Infiltration practices are appealing in that they help to reverse the hydrologic consequences of urban development by reducing peak discharge and providing groundwater recharge. While an infiltration facility may also be equipped with an outlet structure to discharge impounded runoff, such discharge is normally reserved for overflow and other emergency conditions. Since

an infiltration facility impounds runoff only temporarily, it is normally dry during non-rainfall periods. Infiltration basin, infiltration trench, infiltration dry well, and porous pavement are all considered infiltration facilities.

Sand Filters

A sand filter consists of a pre-treatment collection system ahead of a contained bed of sand that acts to filter the first flush of runoff. The runoff is then collected beneath the sand bed and conveyed to an adequate discharge point or infiltrated into the surrounding natural (in-situ) soil profile. Sand filters are commonly used in high-density development by use of an underground containment system for the sand bed.

.

Bioretention

A Bioretention facility is a water quality BMP engineered to filter the water quality volume through an engineered planting bed, consisting of a vegetated surface layer (vegetation, mulch, ground cover), planting soil, and sand bed. A *Bioretention Basin* then ex-filtrates the runoff into the surrounding natural (in-situ) soil profile. A *bioretention Filter* utilizes an under-drain system to collect and convey the filtered runoff to a receiving channel.

Bioretention facilities, or "rain gardens" as they are often called, are basins designed to mimic the conditions found on a mature forest floor by absorbing the initial runoff. When these facilities are spread through out a watershed, the cumulative effect can greatly reduce the volume and frequency of runoff.

Grassed Swales

A grassed swale is an earthen conveyance system that is specifically designed for the purpose of enhancing water quality. Grassed swales are typically broad and shallow with erosion resistant grasses and check dams, and are engineered to remove pollutants from stormwater runoff by filtration through grass and settling behind check dams. In some cases, grassed swales can be modified to provide an engineered soil mixture (similar to bioretention) underneath the flow line to encourage infiltration and absorption, or an under drain system (if necessary) to collect and convey the filtered runoff.

Green Rooftops

A green rooftop is a thin layer of vegetation that is installed on top of conventional flat or slightly sloping roof. Depending on the purpose of the green roof, it can consist of a light weight vegetated system, or an elaborate rooftop landscape or garden. Internal drainage layers serve to moderate the rate of runoff while allowing for water and nutrient uptake by vegetated materials. The vegetation also serves to moderate the daily fluctuation of temperatures that can contribute to thermal pollution in local streams. According to manufacturer literature, green rooftops can often be engineered to

conform to existing load requirements of most roofs–therefore enabling the retrofit of existing buildings.

Manufactured Stormwater BMP Systems

The number of manufactured or proprietary stormwater BMPs has grown over the recent years. In Virginia, manufactured BMPs are grouped into two categories: 1) Hydro-dynamic; and 2) Filtering. The term hydrodynamic refers to a flow through type design that utilizes swirl technologies to separate particulate pollutants from the stormwater. Filtering manufactured BMPs utilize a filter media to filter pollutants from the runoff. These products are typically designed for underground installation and can therefore be used in urban and ultra-urban settings. Further, manufactured BMPs can be utilized in retrofit situations by installing them in an existing pipe system to treat existing runoff.

The reader is strongly encouraged to research these BMPs carefully to determine the best choice for the specific development conditions. The manufacturer should be consulted to determine final costs, design requirements, maintenance requirements, etc.

Virginia is participating in a *Stormwater Best Management Practice Demonstration Tier II Protocol* among several states in order to determine acceptable target pollutant removal efficiency for each product. Further guidance on the target efficiency will be available through DEQ and DCR.

High Efficiency Street Sweeping

Street sweeping is the practice of passing over an impervious surface, usually a street or a parking lot, with a vacuum or a rotating brush for the purpose of collecting and disposing of accumulated debris, litter, sand, and sediments. Street sweeping is widely practiced by urban and suburban governments for litter and dust control. In addition, many commercial establishments utilize street sweeping for aesthetic reasons. Over the last few decades, many researchers have been exploring the utility of street sweeping as a stormwater pollution control measure.

Studies have shown that there are certain times when street sweeping is very effective in improving water quality. In areas with defined wet and dry seasons, sweeping prior to the wet season is likely to be beneficial. Other times when sweeping is beneficial are following snowmelt and heavy leaf fall. However, while street sweeping is effective at removing natural debris and litter, it often fails to contribute significantly to water quality improvements because (1) many street sweepers are ineffective or only slightly effective at removing the micro-sized particles that constitute many pollutants of concern and (2) for street sweeping to be effective, it must be performed frequently and regularly. For instance, if a street sweeper is able to capture X percent of pollutants but sweeping is only performed once a month (with an average of Y storms producing runoff during that time) the pollution removal efficiency will be reduced to X/Y.

Most existing street cleaning techniques are inefficient in picking up fine solids (less than 43 microns) which account for only 5.9 percent of the total solids, but which account for 1/4 of the oxygen demand and 1/2 of the algal nutrient source. This significantly limits the amount of many of the pollutants of greatest concern that can be removed as a result of street sweeping.

Nationwide Urban Runoff Program (NURP) studies indicated that street sweeping produces no significant reduction in nitrogen or phosphorus concentrations in stormwater runoff. NURP data is based on five sites across the United States that compared end-of-pipe NPS pollutant concentrations for swept and unswept conditions. Bivariate plots constructed for the evaluation showed that median concentrations were as likely to be increased as decreased, and that street sweeping never produced a dramatic (over 50 percent) reduction in pollutant concentrations.

A study performed in San Jose, California, however, showed that 50 percent of the total solids and heavy metals could be removed from urban runoff when the streets are cleaned once or twice a day. When the cleaning activities occur once or twice a month, the removal rate dropped to less than 5 percent.

Recent studies have attempted to counter earlier NURP study results. In particular, a 1996 report asserted that the following changes have made street sweeping a more effective form of pollution removal.

- Mechanical sweepers now available are more effective at picking up fine sediments when compared to NURP-era predecessors.

- Regenerative air sweepers, which have been refined considerably since the NURP era, are now more effective at removal fine particles.

- Tandem sweeping (mechanical sweeping followed immediately by vacuum-assisted sweeping) are also more effective than any NURP era machines.

Modeling of street sweeping operations in Portland, Oregon using a Simplified Particulate Transport Model (SIMPTM) found that reductions of up to 80 percent of annual TSS and associated pollutant wash-off might be achieved using bimonthly to weekly sweepings in urban commercial areas.

While no formal monitoring has taken place, reports on regenerative air sweepers indicate that this technology may be more effective in removing finer pollutants (less than 1/1,000th of an inch, or 25 microns), as evidenced by fine particulates trapped in the skimmer hood of the hopper. This may significantly increase the percentage of nutrients and metals available for capture by street sweeping equipment.

APPENDIX E

THE ROLE OF THE CHESAPEAKE BAY PRESERVATION ACT IN CAPPING NUTRIENTS

Local governments in Virginia have had the ability for some time to use their comprehensive plans as well as zoning, subdivision and other land management ordinances to reduce the water quality impacts of new development. Each of these tools can be used to minimize impacts through better planning and site design as opposed to the mitigation, or "end of pipe" approach of conventional stormwater management programs.

Recognizing that there was significant potential to better manage the impacts of development, the 1988 Virginia General Assembly passed the Chesapeake Bay Preservation Act. The Act created the Chesapeake Bay Local Assistance Department (CBLAD) to work with the 84 local governments of Tidewater, Virginia to incorporate new water quality criteria into local land management plans and ordinances. To date, all of the localities have successfully completed Phase I of the Bay Act program by adopting the required maps and ordinances that identify sensitive lands and incorporate measures to protect or manage these lands. Phase II, which entails revising local comprehensive plans to meet Bay Act requirements, should be completed within the next year. Phase III will entail incorporation of additional measures to protect water quality, consistent with the goals and objectives of the Bay Act, into local zoning, subdivision and other land management ordinances. Criteria for Phase III will be developed in the near future. CBLAD is also beginning to focus more on local program implementation issues in order to ensure that local program provisions are being properly applied.

In addition, the Chesapeake Bay Local Assistance Department has undertaken a "Better Site Design" initiative in order to provide information to local governments and the design community on cost-effective ways to reduce the water quality impacts of development. The Better Site Design concept was developed by the Center for Watershed Protection for a national Site Planning Roundtable. In cooperation with the Center and the Virginia Coastal Program, CBLAD has developed a publication entitled *Better Site Design: An Assessment of the Better Site Design Principles for Communities Implementing Virginia's Chesapeake Bay Preservation Act*. This publication focuses on 16 design principles and illustrates their water quality and economic benefits through four Virginia case studies. The principles are organized around the topics of conservation of natural areas, lot development and residential streets and parking lots. When used, these principles can help meet the Bay Act criteria for minimizing impervious surfaces and land disturbance while preserving native vegetation. As demonstrated through the case studies, adherence to the principles may reduce stormwater runoff and its associated nutrient loads; and may result in significant construction cost savings.

Several national development trends incorporate many of the Better Site Design Principles. These include trends toward both open space/clustered development and traditional neighborhood/transit oriented developments. CBLAD has been promoting the use of these principles by holding a number of workshops for local government officials and design professionals in Tidewater, Virginia and plans to continue this outreach effort. The Department will also be moving forward to identify and, where possible, remove local and state impediments to implementing these principles.

Another site design technique that has received increasing attention in Virginia is that of "Low-Impact Development" (LID) which focuses on the concept of replicating predevelopment hydrology. The LID approach combines improved site designs with pollution prevention measures to compensate for land development impacts on hydrology and water quality. It is a comprehensive, technology-based approach to managing stormwater that relies on small, cost-effective landscape features located on each lot rather than large, costly stormwater pond facilities located at the bottom of drainage areas.

Both the "Better Site Design" and "Low-Impact Development" concepts focus on reducing the water quality impacts of development through on-site measures, but do not affect overall development patterns. Other national land management trends, however, are also receiving increasing attention in Virginia and hold the potential to significantly reduce the impacts of new development by altering current land development patterns. Because these practices rely on the use of land management tools already available to Virginia localities, no new enabling legislation is required. Such land management tools include comprehensive plans as wells as zoning and subdivision ordinances,

One trend has been to focus more on redevelopment and infill development. By promoting redevelopment and infill, communities can revitalize existing neighborhoods; promote businesses; provide adequate and affordable housing on existing infrastructure; and reduce the demand for new development and its resulting consumption of open space in outlying areas. Redevelopment and infill also present opportunities to correct some of the water quality problems created by uncontrolled stormwater runoff in older urban areas. Another trend involves linking new development to adequate public facilities and using urban growth boundaries. These practices seek to prevent urban sprawl and ensure that development occurs in an orderly fashion. In both cases, the result can be higher quality, more livable communities with fewer water quality impacts.

If fully implemented throughout a watershed, these techniques have the potential to significantly reduce the water quality impacts of new development. Although some pollutant reductions could be expected when applied to redevelopment, the majority of these techniques focuses on new development and thus have the objective of minimizing new pollutant loads rather than reducing existing ones. As a result, the nonpoint source pollutant load from development is likely to continue to grow as population grows and further reductions in existing pollutant loads will still be required to meet a cap.

Local land management plans and ordinances are the primary mechanisms available for implementing these practices. Although some innovations are occurring at the local level, the majority of new development still follows the same land use patterns and practices that have led to suburban sprawl, urban neglect and degraded water quality. Improving these patterns and practices will require institutional and perhaps even cultural changes with regard to perceptions about alternative development patterns and practices. Fortunately, there are already economic incentives for better development in the form of reduced costs to developers and strong market appeal. In order for these practices to become widespread, however, current impediments, either real or perceived, must be

removed. Also, there must be a much better understanding of these practices among local elected/appointed officials and staff, as well as members of the development/design community. The key challenge will be to provide sufficient outreach and education to these groups in order to affect change. It may also be beneficial to provide incentives for projects that incorporate better design practices in order to demonstrate their application and provide models for other development.

Implementation of the Chesapeake Bay Preservation Act also plays an important role. The goal of the Bay Act is to achieve no net increase in pollutant loading from development. In order to reach this goal, however, the Act must be fully implemented. Also, the Bay Act only affects development in the 84 localities of Tidewater, Virginia. There are another 111 counties, cities and towns in the Chesapeake Bay watershed that may voluntarily enact the provisions of the Act, but are not required to comply.